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The Prediction of Scholastic Success By Intelligence Tests and Scholastic Grades

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THE PREDICTION OF SCHOLASTIC SUCCESS BY INTELLIGENCE TESTS AND SCHOLASTIC GRADES

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CHAPTER I

SCOPE AND PURPOSE OF THE WORK

Guidance is, perhaps, the most important problem which the school administrator has to solve. The introduction of compulsory school attendance laws has increased the enrollment in the grade and secondary schools and as a result has made classification and guidance more necessary.

Since school attendance is compulsory up to the years 16 and 17 it is only fair that the schools provide curricula which meet the needs of the students. Through the science of educational measurements an attempt is being made to discover what curriculum a child should follow. The forecasting of achievement in the various subjects offered in school is the statistical method sometimes used by school authorities to guide them in choosing a curriculum for a student. Forecasting is not a fad. Daily one hears judgments being rendered about a teacher's ability or about a student's chance to succeed in a certain kind of work. In the words of Woody and Sangren (33:1):

> The idea of measurement is as old as civilization itself. The most humble being spends, now as always, a large proportion of his time in making judgments concerning the quantity and quality of things. Everyone is familiar with the fond parent who passes judgment upon the goodness, brightness, or politeness of his own children as compared with similar qualities of his neighbor's children.

Purpose

The purpose of this investigation is to predict scholastic achievement in a private high school from intelligence test scores and from past grade achievement, and to find, if possible, the critical index for success in high school subjects using as bases subject marks and intelligence quotients. In other words, what intelligence quotient or what mark in a subject taken during the previous year is necessary to assure a student success in high school subjects? The leading educationists have not agreed upon the best methods to be used in classifying pupils so as to assure them of reasonable success in school. The problem of classification in the high school has been approached from four viewpoints: (1) past achievement in grade school, (2) general intelligence tests, (3) achievement tests, and, (4) aptitude tests. From the studies to be reviewed in Chapter II it is apparent that low correlations exist between high school achievement as measured by teachers' marks and intelligence test scores. In some instances low correlations are found between high school achievement and past grade school work. These observations do not nullify the results of the studies to be reported, but they do point to the need for discreet judgment on the part of school administrators who classify pupils according to these means. Rector has summarized the problem in this manner (22:28):

> Success in high school may depend upon a number of factors which may be determined before the students leave the elementary school. The difficult problem is to make a judicious selection of elements for prognosis.

Limitations of the Problem

The value of intelligence tests as a basis for prediction in all four years of high school is part of the problem to be considered here. The relation between general intelligence and school achievement should be of interest to the school administrator and teacher alike. It is not the purpose of this investigation to discuss the meaning of intelligence or the degree to which intelligence tests measure what is indicated by the term 'intelligence.' It seems sufficient for this study to accept Colvin's definition of general intelligence "as a group of innate capacities by virtue of which the individual is capable of learning in a greater or less degree in terms of the amount of these innate capacities with which he is endowed" (4:17).

The value of teachers' marks has been criticized because of their subjectivity. The personal equation undoubtedly often enters into a teacher's marking system. However, teachers' marks are probably the best means available at present by which to judge a student's achievement and this system should be maintained until a superior one is found. Most educators will agree that a complete record of a student as indicated by a report card does contain factors which characterize him better than do intelligence tests or achievement tests taken alone.

Chapter II contains a review of some of the important works in the field of high school prediction. All the studies listed were undertaken after the advent of America into the World War. Studies prior to 1917

were not selected because, as stated by Pintner (19:43), the group intelligence test was not developed to any marked degree in the United States until after our entry into the War in 1917.

CHAPTER II

REVIEW OF THE LITERATURE

The investigations to be reviewed in this chapter are divided into the following sections: (1) the relation between intelligence and average scholastic achievement in the first year of senior high school, (2) the relation between intelligence and achievement in algebra, English, history, and Latin in the first year of senior high school, (3) the relation between intelligence and achievement in English, history, Latin, and mathematics in all four years of high school, (4) the relation between intelligence and achievement in the junior high school, and (5) the relation between elementary school marks and achievement in the first year of senior high school.

In order to interpret the findings of the studies to be reported in this chapter it is necessary to know when a coefficient of correlation is significant. Referring to the interpretation of 'r' Chaddock said (3:303-304):

> It may assist the student in interpreting the coefficient if we make rather arbitrary subdivisions of this scale from zero to unity, and characterize each in qualitative terms:
>
> (1) A coefficient less than .3, indicates a low degree of association and doubtful significance, especially if the number of related items is small.
>
> (2) .3 and less than .5, indicates a moderate degree of association if the probable error is small.
>
> (3) .5 and less than .7, indicates marked association.

(4) .7 and less than .9, indicates a high degree of association.
(5) .9 and over, indicates very close association and a very high degree of dependence between the variables.

It is necessary to keep constantly in mind that the interpretation of significance is dependent not only upon the size of the coefficient but also upon the number of related items. Especially when the coefficient is small or only of moderate size, the probable fluctuations due to sampling make it unreliable and of doubtful significance if the number of related items is also small. Repeated experiments with many small samples may increase confidence in the results.

Good maintained that the value of the coefficient should be in the light of past values obtained for similar data. His opinion was expressed in these words (9:23):

It is generally misleading to refer to coefficients in a given range as being "high" and to those in another range as being "low", regardless of the type of data involved. High and low are relative terms. For example, 10 feet would be high for a step but low for a house. A coefficient of .80 is not always high, and one of .25 is not always low (although it may have little significance). The size of a coefficient should be judged in terms of similar results for the same pair of variables; that is, other correlations between measures of the same traits. These similar results are to be sought in the reports of investigations, past and present and future.

Holzinger in his discussion about the meanings often attributed to coefficients of correlation said, among other things (12:165):

> Another custom in dealing with correlation is to classify the coefficients as "high", "Medium", or "low". Thus .75 would generally be regarded as "high", while .25 would be considered as "low". This terminology may be convenient in dealing with test material where the percentage of coefficients above .75 and below .25 is small, but may be misleading when dealing with other types of data. In an age-grade table, for example, a correlation of .75 would be found by comparison with similar coefficients to be relatively low. Another misconception sometimes occurs in interpreting a "high" coefficient, such as .7, as meaning almost perfect agreement.

Odell expressed the interpretations which Rugg and McCall gave to the coefficient of correlation and then added his own opinion (18:171-172):

> Although the coefficient of correlation is a very definite numerical expression which shows the degree or amount of relationship, it is rather difficult to interpret its meaning in ordinary thought and language. The first question that is likely to present itself has to do with how large a coefficient must be to be called high or significant, how small to be called low, etc. Rugg suggests that a correlation of .8 to .9 is very high, one of .5 to .7 high, of .35 to .5 marked, of .20 to .35 low and one of .10 of no significance. McCall's interpretation is somewhat more severe and probably to be preferred. He states that a correlation of less than .4 should be considered low, one of from .4 to .7 substantial, and one of more than .7 high. Any statement of correlation in terms of adjectives is, however, not very satisfactory. A correlation that is comparatively high as correlations go for the sort of data being dealt with may be relatively low when compared with correlations obtained for other data or with perfect correlation.

1. The relation between Intelligence and Average Scholastic Achievement in the First Year of Senior High School

Table I contains thirty correlations found in twelve studies made of the relation between intelligence and average scholastic achievement in the first year of high school. These correlations range from .12 to .715, the median being .49. The median is slightly less than the one found by Hooks (13:11) in a similar study. For twenty-five correlations involving nine studies he found the median to be .53. Upon examining column 3 of Table I it will be noted that the number of cases used in any of these studies does not exceed 369. In most of the studies the number of cases used is less than 65. Some of the correlations were made primarily for classification and for the validation of tests. It was thought permissible to include the findings of such studies in this review.

Flemming (6) analyzed the average scholastic achievement of the pupils in each grade in the Horace Mann High School in the light of achievement and mental tests and upon the opinions of teachers in such matters as character, mental ability, and physical traits in order to find what factors enter into school progress in each of the years in junior and senior high school. Only the findings for the ninth grade were considered in Table I. School achievement was based upon teachers' marks. Intelligence was expressed in a three-fold manner - the pupils in each grade were given the Terman Group Test of Mental Ability, Form B; the

TABLE I

Correlations Between Intelligence and Success in the First Year of High School as Found in Twelve Studies

(1) r	(2) P.E.	(3) No. of Cases	(4) Score Used	(5) Test	(6) Author of Investigation
.715		44	I Q	Otis, Adv. B	Flemming (6:77)
.702		44	I Q	Terman, B	Flemming (6:77)
.69		57	I Q	Otis, Higher Ex.	Miller (13:11)
.635	.060	43	I Q	Otis, Form A	Ludlow (17:12)
.62		57	I Q	Pressey, c.	Miller (13:11)
.61		57	I Q	Terman Group	Miller (13:11)
.60		57	I Q	Miller B	Miller (13:11)
.59		57	I Q	Miller A	Miller (13:11)
.587	.0368	148	I Q	Otis, Higher Ex.	French (8:35)
.58		74	Raw Score	Otis, A and B	West (31:263)
.545	.0685	102	I Q	Simon-Binet	Proctor (20:503)
.519	.070	80	I Q	Otis, Form A	Ludlow (17:12)
.51	.09	32		Otis	Standley (26:19)
.503		55	Raw Score	Haggerty, Delta 2	Haggerty (10:275)
.49	.068	369	Raw Score	Terman Group	Capps (2:63)
.48	.065	60	I Q	Binet	Standley (26:19)
.46	.10	32	I Q	Otis	Standley (26:19)
.424	.033	268	I Q	Otis, Form A	Ludlow (17:15)
.42		57	Raw Score?	Illinois Gen.	Franzen (7:153)
.41		57	Raw Score?	National, B	Franzen (7:153)
.37		79	Per. Rank	Terman	Ross (23:36)
.367	.090	41	I Q	Otis, Form A	Ludlow (17:12)
.33	.0677	82	Per. Rank	Otis, Terman	Hooks (13:28)
.31		57	Raw Score?[1]	Otis	Franzen (7:153)
.30		57	Raw Score?[1]	Terman	Franzen (7:153)
.29		57	Raw Score?[1]	Haggerty	Franzen (7:153)
.29		57	Raw Score?[1]	Dearborn, 1	Franzen (7:153)
.29		57	Raw Score?[1]	National, A	Franzen (7:153)
.24		57	Raw Score?[1]	Dearborn, 2	Franzen (7:153)
.12		57	Raw Score?[1]	Myers	Franzen (7:153)

1. It was impossible to tell from the study reported by Franzen whether the raw scores or the ingelligence quotients were used.

Miller Mental Ability Group Test, Form A; and the Otis Self-Administering Test of Mental Ability, Form B. Separate IQ's were recorded for the results of each test. The character of each student was expressed in the average score given by at least three teachers on a rating scale containing ten traits composed by Flemming.. Chronological age was the physical factor used in the investigation. Flemming correlated separately the score made on each factor with average scholastic achievement in each grade. She found intelligence quotients to be the factor which correlated the highest with the average of the school marks earned in the ninth grade.

As pointed out by Hooks (13:12), Miller was concerned with test validation. He correlated the IQ's and the grades earned by 57 freshmen in the University of Minnesota High School. Miller concluded from the coefficients of correlation that the tests used were valid for classification purposes.

Ludlow (17) made a study of the value of the factors, intelligence, vocabulary comprehension, and reading comprehension, as determined by the Otis Intelligence Test, Higher Examination, Form A, the Inglis Test of English Vocabulary, and the Chapman Unspeeded Reading-Comprehension Test, for predicting high school marks. The total number of cases studied was 2,326, taken from grades IX to XII. Twenty-five high schools submitted data for the study. Only the cases reported for the ninth grade were included in Table I. Ludlow found that: (1) intelligence test scores were a better criterion than the scores of the Inglis Vocabulary

Test or those of the Chapman Unspeeded Reading-Comprehension Test for predicting scholastic achievement, (2) a school that ranked high in one set of correlations may have ranked low in one or both of the other sets of correlations, (3) the use of partial correlation showed that the mean value of the coefficient of correlation between achievement in all four years of high school and intelligence was .414, partialing out vocabulary and reading scores, and (4) the use of partial correlation showed that the mean value of the coefficient between achievement in all four years of high school and vocabulary scores was .323, partialing out intelligence and reading.

In the investigation reported by French (8) the following items were considered in their relation to predicting achievement in the first year of high school: eighth grade marks, Otis Mental Test, Stanford Achievement Test, chronological age, and a composite of these criteria. The data consisted of 148 students in the sophomore and junior classes of the Martinsville, Indiana, High School. All these pupils had received their previous school training in the grade schools and in the first year of the high school in Martinsville. French concluded that the Otis Mental Test ranked second to the average of eighth grade marks in predicting freshman high school achievement.

West (31) made a study of the Otis Intelligence Test, Forms A and B, to see if they could be used to encourage students to work up to their mental ability, and to see if intelligence tests correlated with teachers' marks to a significant degree. The records of 74 freshmen in the Needham,

Massachusetts, High School were used. His conclusion was that the coefficient of .58 showed that there was a marked tendency for intelligence tests and teachers' marks to correlate. West also found that in 22 cases test scores had stimulated pupils to do better work.

Proctor, (20,21) conducted a two-fold investigation: (1) he studied the validity of the Stanford Revision of the Binet-Simon Intelligence Scale in predicting achievement in high school, and (2) he studied the usefulness of the Binet Test in guiding high school pupils in the selection of their studies. Only the first part of Proctor's work was considered in this thesis because it was related to the problem to be studied in the next chapter.

One hundred and seven pupils in the Palo Alto High School, comprising the IX A and the IX B classes, were studied for the scholastic year 1916-1917. Four months after the Binet Test had been given the teachers were asked to estimate the intelligence of each pupil under their charge. The judgments were recorded on a five-point scale ranging from "very superior" to "very inferior." Only those who had been rated by at least three teachers were included in the study. This method of procedure reduced the total number of cases to 102. The value of the coefficient of correlation between intelligence as defined by the Binet Test and achievement as defined by teachers' marks in the first year of high school was $.545 \pm .0685$. Proctor next correlated the intelligence of the 102 students as defined by the teachers' estimates with their school achievement. He found the coefficient to have a value of $.702 \pm .0518$. Proctor said this

high positive correlation was due to the teachers basing their estimate of a child's intelligence upon the quality of the work he did in their classes. Proctor concluded that it seemed reasonable to believe intelligence was reflected in school marks. Concerning the use of intelligence tests to predict achievement in school, he said "The significant point in favor of the mental test is that it can be administered in a few minutes while it takes a teacher several weeks usually to arrive at an estimate of the intelligence of the members of his class, and school marks are not available until the middle or end of a semester" (20:506).

Standley (26) reported his work in prognosis with 32 freshmen students in the Oak Park and River Forest Township High School. The criteria used to determine high-school achievement were the Binet Intelligence Test, the Otis Group Intelligence Test, and the average of eighth grade marks. Besides the coefficients of correlation given in Table I, Standley found the value for 'r' when eighth grade achievement was correlated with the marks earned by freshmen in their first semester in high school. The coefficient of correlation was .46 .065. Standley's opinion was that eighth grade marks were about as valuable as the Binet and Otis Tests for predicting first year high school achievement because all three criteria yielded about the same coefficient in value when correlated with high school achievement. Standley found practically no difference between the use of the Binet and the Otis Tests as instruments for predicting scholastic achievement in the freshman year in high school.

Franzen (7) gave 14 intelligence tests to 57 high school freshmen in Des Moines, Iowa, and correlated the score on each test with the average grade earned by each student in the first semester in high school in order to find out if intelligence test scores were criteria of scholastic achievement in the ninth grade. The correlations ranged from .42 to .12. Franzen also correlated the score earned by each student on each intelligence test with the teachers' judgment of his "power to adapt" (7:153). The values of these coefficients of correlation were not reported, but Franzen did say that they were higher than the coefficients obtained between the intelligence test scores and achievement in the first semester of high school.

Haggerty (10) gave the Haggerty Intelligence Examination, Delta 2, to high school pupils in order to obtain a revised table of age norms. He correlated the scores received on his test with the grades earned by 55 ninth grade pupils in the University of Minnesota High School. Scholastic achievement represented 12 weeks' work. Haggerty believed that, in comparison with other studies, the coefficient of .503 was significant for predicting scholastic achievement in the ninth grade.

Capps (2) studied the value of the Terman Group Test as a means of predicting the achievement of high school freshmen. The 369 cases were distributed in 6 secondary schools in southern Missouri. Capps also correlated the average of the eighth grade marks with the average of the first semester marks earned by the freshmen. He found the correlation between eighth grade marks and those for the first semester in high

school ranged from .51±.07 to .80±.04. Capps concluded that eighth grade marks were more reliable for predicting achievement in the first semester of high school than were intelligence test scores. He added that the Terman Group Test of Mental Ability is often available when eighth grade marks are not and that it may be used for these purposes: (1) to divide children into groups in which their needs will be considered, (2) to indicate problem cases, and (3) to discover pupils with low mentality who need encouragement, and those with high mentality who need to be stimulated in order to do work worthy of their ability.

Ross (23) in his investigation of the relation of intelligence and school marks made a comparison between four standardized tests in predicting achievement in general average, English, Latin, and mathematics. For the Terman Group Test his coefficients of correlation were .37, .46, .18, and .42, respectively. His results showed that grade school composites possessed more value for prognosis in the first year of high school than intelligence tests. Ross offered the following suggestion in regard to which factors should enter into the prediction of high-school achievement (23:44):

> The best basis for predicting high school success would seem to be a combination of the following: Intelligence ratings, to afford some meature of native endowment; standard achievement tests, to give objective evidence as to prerequisite academic preparation; and teachers' ratings in the grades, to afford a measure of the attributes and moral habits already acquired, which are such important factors in determining high school success.

2. The Relation between Intelligence and Achievement in Algebra, English, History, and Latin in the First Year of Senior High School

Table II contains the coefficients of correlation found between intelligence test scores and scholastic achievement in ninth grade algebra, English, history, and Latin. It will be noted that, on the whole, the coefficients of correlation in Table II between the grades earned in English and the scores earned on the Terman Group Test of Mental Ability, expressed as percentile ranks, are higher than the other three groups.

Ross (23) correlated the scores on the Terman Group Test of Mental Ability with each of the first year high school subjects and found the largest coefficient between intelligence test scores and achievement in English and the smallest coefficient between intelligence and achievement in Latin.

Todd (29) studied the usefulness of the Terman Group Test of Mental Ability as a means of predicting achievement in grades IX and X. He also correlated the scores of the single tests of which the Terman Group Test is composed with achievement in grades IX and X. These coefficients of correlation ranged from .09 to .40. He considered these values insignificant for predictive purposes. Todd concluded that the coefficients of correlation between intelligence quotients and achievement in algebra, English, history, and Latin were useful for predicting achievement in the

TABLE II

Correlations Between Intelligence and Success in Algebra, English, History, and Latin in the Ninth Grade

(1) Subject	(2) r	(3) P.E.	(4) No. of Cases	(5) Score Used	(6) Test	(7) Author of Investigation
Algebra	.42		79	Per. Rank	Terman	Ross (23:36)
Algebra	.389	.029	397	Raw Score	Terman, A and B	Todd (29:38)
Algebra	.37		75[1]	I Q	Otis, Adv. A, B	Schmitz (24:67)
Algebra	.32	.03	828[1]	I Q	Otis, Terman	Hoke (11:25)
Algebra	.31	.0677	82	Per. Rank	Otis, Terman	Hooks (13:28)
Algebra	.284	.031	397	Raw Score	Terman, A, B	Todd (29:38)
Algebra	.123		528[1]	I Q	Otis, Adv., A, B	Schmitz (24:67)
English	.592	.067	43	I Q	Otis, Form A	Ludlow (17:27)
English	.523	.069	50	I Q	Otis, Form A	Ludlow (17:27)
English	.49		76[1]	I Q	Otis, Adv., A, B	Schmitz (24:67)
English	.46		79	Per. Rank	Terman	Ross (23:36)
English	.42	.0571	82	Per. Rank	Otis, Terman	Hooks (13:28)
English	.39	.02	1,012[1]	I Q	Otis, Terman[2]	Hoke (11:25)
English	.39	.091	41	I Q	Otis, Form A	Ludlow (17:27)
English	.376[3]	.029	397	Raw Score	Terman, A, B	Todd (29:42)
English	.33		529[1]	I Q	Otis, Adv., A, B	Schmitz (25:60)
English	.287[4]	.031	397	Raw Score	Terman, A, B	Todd (29:42)
History	.435		525[1]	I Q	Otis, Adv., A, B	Schmitz (25:60)
History	.367[4]	.034	293	Raw Score	Terman, A, B	Todd (29:42)
History	.36	.04	206[1]	I Q	Otis, Terman[2]	Hoke (11:25)
History	.256[4]	.038	293	Raw Score	Terman, A, B	Todd (29:42)
Latin	.50		79[1]	I Q	Otis, Adv., A, B	Schmitz (24:67)
Latin	.41	.03	347[1]	I Q	Otis, Terman[2]	Hoke (11:25)
Latin	.355	.042	200	Raw Score	Terman, A, B	Todd (29:49)
Latin	.33		516[1]	I Q	Otis, Adv., A, B	Schmitz (25:60)
Latin	.33	.0677	82	Per. Rank	Otis, Terman	Hooks (13:28)
Latin	.205[3]	.044	204	Raw Score	Terman, A, B	Todd (29:49)
Latin	.18		79	Per. Rank	Terman	Ross (23:36)

1. These cases consist only of boys.
2. The Otis and Terman Group Intelligence Tests were used in nine high schools. The coefficients were averaged for each subject.
3. This coefficient is based on first semester marks only.
4. This coefficient is based on second semester marks only.

ninth grade, while the coefficients found between intelligence quotients and achievement in the commercial subjects and civics were too low to be of use in the forecasting of academic achievement in the first year in high school.

Schmitz (24) reported the results of his work in the prevention of failure in grades IX and X by the use of the Otis Intelligence Test. Using an Intelligence Quotient of 95 and an Educational Age of 155 months, respectively, as arbitrary criteria of achievement he found it possible to predict achievement in algebra in 80 cases out of 100, and in 82 cases out of 100 in Latin. He concluded that the pupils with an IQ between 90 and 100 were the critical cases and should be administered another group test of intelligence or, better still, individual mental tests.

In a follow-up study Schmitz (25) verified his findings in the first investigation. He reported that a student with an IQ above 110 had 9 chances to 1 to succeed in Latin; 8 chances to 1 in algebra; 16 chances to 1 in history; and 16 chances to 1 in English. A pupil with an IQ of 95 or below had a 1 to 1 chance to succeed in Latin; 4 chances to 1 in algebra; 2 chances to 1 in English and history. Schmitz concluded that intelligence tests were very useful in the educational guidance of freshmen high school students.

Hooks (13) compared the value of grade-school composites of achievement with intelligence test scores expressed as percentile ranks as a basis for predicting achievement in the ninth grade. He found that

grade school achievement correlated much higher with first year high school achievement than intelligence tests did. The coefficient of correlation between a composite of grade-school factors and achievement in the first year of high school was .69±.04. The coefficient of correlation between intelligence and ninth grade marks was .33±.0677. Hooks concluded tentatively that, considering the small number of cases, it appeared composites of grade school factors were more useful than intelligence tests for predicting achievement in the first year of high school.

Hoke (11) studied the relationship between achievement in the ninth grade and intelligence quotients. He obtained his data from 9 high schools situated in Ohio, Pennsylvania, and West Virginia. He computed separate correlations for boys and for girls. Only the correlations pertaining to the boys were reported in Table II because this investigation and the ones reported by Schmitz (24,25) were the only ones containing correlations for boys alone. Hoke's complete study consisted of correlations between the intelligence quotients of boys and their achievement in 24 ninth grade subjects and of correlations between the intelligence quotients of girls and their achievement in 24 ninth grade subjects. For both sets of correlations the coefficients ranged from .56±.03 to -.04±.05. Hoke said that, among other things, the following statement seemed to be warranted by the study (11:73): "The degree of correlation between intelligence and scholarship indicates that there are other factors as potent as intelligence in determining the success of pupils in the subjects."

3. The Relation between Intelligence and Achievement in English, History, Latin, and Mathematics in all Four Years of High School

Table III contains the coefficients of correlation found in 4 studies between intelligence quotients and achievement in English, history, Latin, and mathematics in all four years of high school.

Jordan (14) studied the use of the Army Alpha, Otis, Miller, and Terman Group Tests in order to find (1) which elements of the 4 tests were the best prognostic instruments of achievement in the first year of high school when they were correlated with the average of all marks earned during the year and (2) which intelligence test correlated the highest with achievement in first year English, history, mathematics, and general science. The data consisted of the intelligence scores and scholastic grades of 67 students in the University of Arkansas Training High School. Jordan considered the test 'best' which had either one of its sections or the entire test correlate the highest of the 4 intelligence tests with achievement in a specific subject. He found the Terman Group Test correlated the highest with average achievement in all subjects. The coefficient of correlation was .555. His study also showed that the Miller Test was the best to predict achievement in English. The coefficient of correlation between the scores earned on Test I of the Miller Test and achievement in first year English was .594. The Terman Group Test was found to be the best for predicting achievement in history. The coef-

ficient of correlation between the scores earned on Test VI of the Terman Test and achievement in first year history was .588. The Otis Test was the best to predict achievement in mathematics. The coefficient of correlation between the scores earned on Test V of the Otis Test and achievement in first year mathematics was .676. The Terman Test was the best to predict achievement in general science. The coefficient of correlation between the scores earned on the Terman Test, as a whole, and achievement in general science was .636.

The investigation reported by Rector (22) was concerned with the validity of intelligence quotients as determined by the Army Alpha Test and scholarship and application ratings based on the average of the estimations given by at least three teachers as means of predicting achievement in the University High School at Oakland, California. The data consisted of the intelligence scores and scholastic achievement of 431 tenth grade students. The scholarship and application ratings of the same pupils were based on the average of three teachers' ratings. These ratings were made while the students were in their last semester in grade school. Correlations were computed between the ingelligence quotients and achievement in the tenth grade and between intelligence quotients and scholarship and application ratings. The first set of correlations were reported in Table III. The coefficient of correlation between intelligence quotients and achievement in English was .25±.015; that between intelligence quotients and achievement in history was .33±.028; that between intelligence quotients and achievement in Latin was .38±.042; and that

between intelligence quotients and achievement in mathematics was .28±.021. In the second set of correlations the values of the coefficients ranged from -.06 between scholarship and shop achievement to .54 between scholarship and mathematics. The correlation between all subjects combined and intelligence quotients was .28; that between all subjects combined and scholarship was .25; and that between all subjects combined and application was .25. Rector concluded from these two sets of correlations that intelligence, scholarship and application were not valid means for predicting scholastic achievement in the tenth grade.

Whaley (32) reported her work in the use of the Otis and Terman Tests to predict success in the social sciences for grades IX to XII in five high schools. Whaley found the highest coefficients of correlation between intelligence and achievement in civics - for the two high schools offering civics, the Abraham Lincoln High School of Los Angeles, California, with 74 cases, had the higher correlation, the value of the coefficient being .55±.0552. The Oak Park and River Forest Township High School of Oak Park, Illinois, with 30 cases, had a coefficient of correlation of .50±.0924. The correlations between intelligence and achievement in history in the five high schools ranged from .29±.0601 to .42±.0366. Whaley remarked that the Otis and Terman Tests had about equal predicatability for civics and history.

The work of Schmitz (24,25) was referred to in Table II. He found the correlation between the Educational Age and each subject to be higher than between the Intelligence Quotients and each subject. The coefficient

TABLE III

Correlations Between Intelligence and English, History, Latin, and Mathematics in All Four Years of High School as Found in Four Studies

(1) Subject	(2) r	(3) P.E.	(4) No. of Cases	(5) Score Used	(6) Test	(7) Author of Investigation
English	.564	.057	64	I Q	Miller	Jordan[1] (14:422)
English	.523	.061	64	I Q	Terman	Jordan[1] (14:422)
English	.472	.065	64	I Q	Army Alpha	Jordan[1] (14:422)
English	.466	.065	64	I Q	Otis	Jordan[1] (14:422)
English	.25	.015	431	I Q	Army Alpha	Rector (22:31)
History	.42	.0366	232	I B	Otis	Whaley (32:40)
History	.42	.0603	86	I B	Otis	Whaley (32:40)
History	.408	.121	20	I Q	Terman	Jordan[1] (14:426)
History	.33	.028	183	I Q	Army Alpha	Rector (22:31)
History	.319	.136	20	I Q	Army Alpha	Jordan[1] (14:426)
History	.31	.0414	220	I Q	Terman	Whaley (32:40)
History	.29	.0601	105	I Q	Otis	Whaley (32:40)
History	.262	.140	20	I Q	Otis	Jordan[1] (14:426)
History	.168	.148	20	I Q	Miller	Jordan[1] (14:426)
Latin	.38	.042	59	I Q	Army Alpha	Rector (22:31)
Mathematics	.53		71	I Q	Otis, Adv. A,B	Schmitz (24:67)
Mathematics	.511	.073	47	I Q	Army Alpha	Jordan[1] (14:424)
Mathematics	.456	.077	47	I Q	Miller	Jordan[1] (14:424)
Mathematics	.436	.079	47	I Q	Terman	Jordan[1] (14:424)
Mathematics	.430	.079	47	I Q	Otis	Jordan[1] (14:424)
Mathematics	.28	.021	285	I Q	Army Alpha	Rector (22:31)

1. Jordan's correlations are based on the average of one year's marks and are higher than the correlations between intelligence and marks averaged for three terms.

of correlation between the intelligence quotients and achievement in geometry was .53, while the coefficient of correlation was .62 between the educational ages and achievement in geometry.

Table III shows the correlations found in four studies between intelligence and achievement in English, history, Latin, and mathematics in the four years of high school. In Table II, column 2, the range in the values of the coefficients of correlation between intelligence and achievement in algebra for seven separate correlations was .42, based upon 79 cases, to .123, based upon 528 cases. In Table III, column 2, the range in the values of the coefficients of correlation between intelligence and achievement in mathematics for six separate correlations was from .53, based upon 71 cases, to .28, based upon 285 cases. In Table II, column 2, the range in the value of the coefficients of correlation between intelligence and achievement in English for ten separate correlations was from .592, based upon 43 cases, to .287, based upon 397 cases. In Table III, column 2, the range in the value of the coefficients of correlation between intelligence and achievement in English for five separate correlations was from .564, based upon 64 cases, to .25, based upon 431 cases. In Table II, column 2, the range in the value of the coefficients of correlation between intelligence and achievement in history for four separate correlations was from .435, based upon 525 cases, to .256, based upon 293 cases. In Table III, column 2, nine separate correlations were reported between intelligence and achievement in history. The coefficients of correlation varied in value from .42, based upon 232 cases, to .168, based upon 20 cases.

In Table II, column 2, seven separate correlations were given between intelligence and achievement in Latin. The value of the coefficients of correlation ranged from .50, based upon 79 cases, to .18, based upon 79 cases. Table III, column 2, contains only one coefficient of correlation between intelligence and achievement in Latin. The coefficient was .38, based upon 59 cases. The correlations in Table II and in Table III were reasonably consistent for each subject. Table II showed the correlations found between intelligence and scholastic achievement in algebra, English, history, and Latin in the ninth grade and Table III contained the correlations between intelligence and English, history, Latin, and mathematics in all four years of high school.

It appeared from the studies just mentioned that the value of the coefficients of correlation between intelligence, as determined by group test scores, and achievement in the first year of high school, as determined by teachers' marks, ranged from .40 to .70. The correlations between intelligence test scores and achievement in the separate subjects seemed to be a little lower in value.

4. The Relation between Intelligence and Achievement in Junior High School

The investigations mentioned so far in this chapter have referred to senior high schools. This section contains a review of some of the studies of prognosis made in the junior high school field.

Brooks (1) made a study of the value of fifth and sixth grade marks

and group tests of achievement and intelligence for the purpose of finding a satisfactory basis for sectioning incoming freshmen in the Fulton Junior High School in Baltimore, Maryland. The records of 93 pupils were studied. The criteria of achievement in the seventh grade were the average of seventh grade marks in English, geography, history, and mathematics, and educational age obtained from the Stanford Achievement Test. The intelligence tests used were the Miller, Form A; Otis: Illinois, Form A; Terman, Form A; Haggerty, Delta 2; National Intelligence Test, A 1; Dearborn, Revised C and D; Pintner Non-Language Test.

Brooks found that the average intelligence quotient correlated .67 with the marks used as a criterion of achievement in the seventh grade. He concluded that "Absolutely perfect predictive measures may never be found just because growth or development may of itself introduce a certain amount of change or variation which will continue to elude accurate estimate" (1:369).

Courter (5) reported his study of the factors which condition achievement in plane geometry in the junior high school. His criteria of achievement consisted of (1) the student's strength of purpose in the subject, (2) his general intelligence, and (3) his special ability in the subject. One hundred and sixty-nine geometry students in Flint, Michigan, were selected at the beginning of the second semester of the scholastic year 1923-1924 for the investigation. They were given the Terman Group Test of Intelligence, Form A, and the Otis Test, Form A. A composite intelligence rating for each pupil was obtained by combining his Index of

Brightness and his Intelligence Quotient and finding the arithmetic mean. Special ability in mathematics was determined by the Rogers' Prognostic Test of Mathematical Ability. The student's strength of purpose in attacking the subject was measured by a questionnaire. At the end of the semester the Sanford Achievement Test in Plane Geometry was given to the pupils who had finished both semesters of the subject. Those who had studied only the first semester's content were given a test composed by the teachers in the mathematics department.

Courter obtained these coefficients of correlation:

No. of Cases	Score Used	Purpose and Achievement		Intelligence and Achievement		Ability and Achievement	
	Average of	r	P.E.	r	P.E.	r	P. E.
169	Terman IQ - Otis I B	.66	.03	.56	.03	.60	.03

Courter concluded from the above coefficients that a pupil's strength of purpose has a greater effect upon his achievement in plane geometry than does either his general intelligence or his mathematical ability. He considered the latter two about equal in value for predicting achievement in the subject.

Flemming (6) analyzed various traits for junior and senior high school pupils in order to evaluate them with reference to their significance for academic achievement. She used tests of achievement, intelligence, and personality, and teachers' judgments of character and intelligence. All her data were obtained in the Horace Mann High School, a private high school under the supervision of Columbia University in New York City.

The intelligence quotient which each student obtained from each of the three intelligence tests, Terman, Form A; Miller, Form A; and Otis, Form B, was correlated separately with his average achievement in English literature, history, Latin, and mathematics in grades VII, VIII, and IX. Each of the following coefficients of correlation was the mean coefficient obtained between the average intelligence test score of each intelligence test and the average achievement of all students in each subject.

No.of Cases	Mean School Achievement		Eng. Lit.		History		Latin		Mathematics	
	40		40		40		40		40	
	r	P.E.	r	P.E.	r	P.E.	r	P.E.	r	P.E.
Terman, FormA	.5972	.07	.4923	.08	.5354	.08	.5280	.09	.4866	.08
Miller, FormA	.4688	.08	.3507	.09	----	--	.4280	.10	.3738	.09
Otis, FormB	.5237	.08	.4574	.08	----	--	.5680	.08	.5167	.08

Flemming found the simple and multiple coefficients of correlation were high between intelligence and achievement scores, school marks, school attitude, physical energy, and chronological age. The correlations ranged from .70 to .90. Perhaps, as Symonds suggested (27:396), these high simple and multiple coefficients were due to the fact that the tests were given during the year that the grades were earned.

Lange (15) used the Intelligence Quotients obtained from the Otis Self-Administering Test of Mental Ability, Forms A and B, to predict achievement in the junior high school as measured by teachers' marks. Her data were taken from the records of the Franklin Junior High School in

in Racine, Wisconsin. She computed separate coefficients of correlation between intelligence and the average of the marks received in grades VII, VIII, and IX. Among the correlations worked out by Lange were the following:

TABLE IV

Correlations Between School Marks and Intelligence Quotients

(1) Subject	(2) Grade in School	(3) No.of Cases	(4) Test	(5) r	(6) P.E.
English	Seventh	387	Otis, Forms A,B	.588	.022
English	Eighth	405	Otis, Forms A,B	.585	.022
English	Ninth	378	Otis, Forms A,B	.603	.022
Mathematics	Seventh	375	Otis, Forms A,B	.438	.028
Mathematics	Eighth	393	Otis, Forms A,B	.541	.024
Mathematics	Ninth	301	Otis, Forms A,B	.490	.031
Social Subjects	Seventh	375	Otis, Forms A,B	.445	.028
Social Subjects	Eighth	413	Otis, Forms A,B	.576	.022
Social Subjects	Ninth	395	Otis, Forms A,B	.511	.024
Latin	Eighth	97	Otis, Forms A,B	.43	.057
Latin	Ninth	90	Otis, Forms A,B	.450	.057

Some of the conclusions which the study seemed to warrant were: (1) intelligence as measured by the Otis Test was an important factor in predicting achievement in the junior high school grades because the number of pupils with low intelligence quotients decreased from grade to grade, (2) intelligence quotients correlated the highest with English; the second highest with mathematics, (3) there was considerable variation in the size

of the coefficients of correlation obtained between intelligence and the different subjects, and (4) the Otis Test was not useful to predict achievement in individual cases.

5. The Relation between Elementary School Marks and Achievement in the First Year of Senior High School

The use of elementary school marks to predict achievement in high school is an older method than the two already described. Symonds (27:392) pointed out that Miles was the first to follow this plan. He averaged all the grades earned by a pupil in the elementary school and all his grades in the high school and correlated the two sets of averages. Miles obtained a coefficient of correlation of .71.

Ross (23) has made, perhaps, the most extensive study of elementary school records as a means of predicting achievement in high school. He secured his data from four elementary schools and one high school in New Rochelle, New York, for the years 1916, 1917, 1918, and 1919. He obtained for a check-up measure the elementary records of 120 freshmen who entered the West High School, Des Moines, Iowa, in the fall of 1922 from eight elementary schools.

Ross correlated separately the achievement in English, Latin, and mathematics in the first year of high school with a composite of grade school factors and compared the coefficients of correlation obtained in New Rochelle and in Des Moines. These coefficients of correlation

are reported in Table V.

Apparently Ross did not favor the use of an intelligence test as the sole factor in predicting high school achievement. Among his conclusions he said (23:44):

> The best basis for predicting high school success would seem to be a combination of the following: Intelligence ratings, to afford some measure of native endowment; standard achievement tests, to give objective evidence as to prerequisite academic preparation; and teachers' ratings in the grades, to afford a measure of the attitudes and moral habits already acquired, which are such important factors in determining high school success.

As far as could be ascertained from available sources Ross was the only one who had predicted persistence in secondary school attendance. He found these factors to be significant when correlated with persistence; age at the end of grade 8; English, grades 7-8; effort, grades 7-8; and days present, grades 4-6, Ross obtained the following coefficients of correlation:

YEAR	NO. OF CASES	r
1916	141	.63
1917	200	.63
1918	214	.52
1919	194	.54

Hooks (13) compared the relative value of intelligence tests and grade-school records for predicting achievement in the first year of high school. Complete scholastic records from grade II through grade IX were secured for 82 cases - 9 from the schools of Lexington and 73 from Paris,

Kentucky. The pupils in Lexington had been given the Terman Group Test of Intelligence and those in Paris the Otis Group Test. The results of both tests were expressed in percentile rank and were correlated with the transmuted scores made in ninth-grade progress. Hooks assigned arbitrary weights ranging from 10 to -10 to the marks earned in grade school and in the first year of high school and to the factors 'days present' and 'grade-progress.' He also computed coefficients of correlation between composits of grade school marks and achievement in the first year of high school.

Table VI contains the coefficients of correlation found between grade school composites and achievement in the ninth grade. The coefficients of correlation between the scores made on the two intelligence tests and the marks earned in the first year of high school in Table II.

Hooks found lower coefficients of correlation between intelligence test scores and achievement in first year high school than between grade school records and achievement in first year high school.

TABLE V

Correlation of Grade School Composite with the Marks Earned in English, Latin, and Mathematics in the First Year of High School for Four Successive Years in New Rochelle, New York, and for One Year in Des Moines, Iowa

(1) Subject	(2) Year	(3) Location	(4) Grade School Composite	(5) No.of Cases	(6) r	(7) P.E.
English	1916	New Rochelle	*	102	.60	.046
English	1917	New Rochelle	*	134	.67	.037
English	1918	New Rochelle	*	139	.67	.037
English	1919	New Rochelle	*	137	.60	.036
English	1922	Des Moines	*	120	.61	.038
Latin	1916	New Rochelle	**	51	.58	.065
Latin	1917	New Rochelle	**	57	.73	.047
Latin	1918	New Rochelle	**	58	.57	.059
Latin	1919	New Rochelle	**	62	.64	.050
Latin	1922	Des Moines	**	120	.61	.038
Mathematics	1916	New Rochelle	***	101	.42	.055
Mathematics	1917	New Rochelle	***	134	.51	.042
Mathematics	1918	New Rochelle	***	141	.43	.046
Mathematics	1919	New Rochelle	***	137	.51	.042
Mathematics	1922	Des Moines	***	120	.51	.045

* This correlation was based upon a grade school composite of English, grades 4-6; English, grades 7-8; age at end of grade 8; and special subjects, grades 7-8.

** This correlation was based upon a grade school composite of English, grades 7-8; arithmetic, grades 7-8; history, grades 5-6; age at end of grade 8; days present, grades 4-6; days present, grades 2-3; and grade progress.

***This correlation was based upon a grade school composite of arithmetic, grades 7-8; English, grades 4-6; special subjects, grades 7-8; grade progress; and days present, grades 2-3.

TABLE VI

Correlation Between Grade School Records and Success in the First Year of High School in Lexington and Paris, Kentucky

(1) Subject	(2) No. of Cases	(3) Test Used	(4) r	(5) P.E.
General Average	82	Otis, Terman	.69	.0405
English*	82	Otis, Terman	.67	.0426
Latin**	82	Otis, Terman	.55	.0534
Mathematics***	82	Otis, Terman	.43	.0621

* This correlation was based upon a grade school composite of age at end of grade 8; English, grades 4-6; and English, grades 7-8.

** This correlation was based upon a grade school composite of age at end of grade 8; grade progress; English, grades 7-8; arithmetic, grades 7-8; history, grades 5-6; days present, grades 2-3; and days present, grades 4-6.

***This correlation was based upon a grade school composite of grade progress; English, grades 4-6; arithmetic, grades 7-8; and days present, grades 2-3.

Summary

All the studies reviewed in this Chapter used intelligence tests to predict achievement. Perhaps, as pointed out by Trabue (30:173), the value of intelligence tests in guidance work has been determined in the past by the calculation of coefficients of correlation between intelligence test scores and school marks. No study was found in which school records alone were used. Ross (23) relied less upon the intelligence test than other investigators. The fact that he was able to secure the complete grade school records of 749 students may account for the method he used to explain his data.

The studies reported in this chapter have approached the problem of prediction of achievement in high school from different points of view; (1) the correlation of intelligence test results with achievement in the ninth grade, (2) the correlation of intelligence test results with achievement in first-year algebra, English, history, and Latin, (3) the correlation of intelligence with the marks earned in English, history, Latin, and mathematics in all four years of high school, (4) the correlation of intelligence with achievement in the junior high school grades, and (5) the correlation of elementary-school marks with achievement in the first year of secondary work.

In Table I which contained the coefficients of correlation between intelligence and average achievement in the first year of high school

column 1 showed a range in the value of the coefficients from .715 to .12. The former coefficient was based upon 44 cases and the latter upon 57 cases. Capps' study (2) contained the largest number of cases. He gave the Terman Group Test to 369 ninth grade pupils and correlated their intelligence test scores with their achievement in the first year of high school. The coefficient of correlation was .49±.068.

Table II which contained the coefficients of correlation between intelligence and achievement in algebra, English, history, and Latin showed a wide range in the value of the coefficients for each subject. In column 2 the values of the coefficients of correlation between intelligence and achievement in algebra ranged from .42, based upon 79 cases, to .123, based upon 528 cases. The highest coefficient of correlation obtained between intelligence and achievement in English was .592±.067, based upon 43 cases, and the lowest was .287±.031, based upon 397 cases. The values of the coefficients of correlation between intelligence and achievement in history ranged from .435, based upon 525 cases, to .256, based upon 293 cases. The greatest range of values in the coefficients of correlation occurred between intelligence and achievement in Latin. The coefficients ranged from .50, based upon 79 cases, to .18, based upon 79 cases.

Table V showed the coefficients of correlation between grade school composites and the marks earned in the first year of high school in two cities for different years. The coefficients of correlation between grade school composites and achievement in English ranged from .60±.046, based upon 102 cases, to .67±.037, based upon 139 cases. The coefficients of

correlation between grade school composites and achievement in Latin ranged from .73±.047, based upon 57 cases, to .57±.059, based upon 58 cases. The coefficients of correlation between grade school composites and achievement in mathematics ranged from .51±.042, based upon 137 cases, to .42±.055, based upon 101 cases.

The coefficients of correlation in Table VI between grade school records and achievement in English, Latin, and mathematics, each based upon 82 cases, were as follows: that between grade school composites and achievement in English was .67±.0426; that between grade school composites and achievement in Latin was .55±.0534; and that between grade school composites and achievement in mathematics was .43±.0621.

Many of the studies reported in this chapter contained data for less than 100 cases. The number of coefficients of correlation in each table, based upon 100 or more cases, was as follows: Table I had, of 30 coefficients, only 4 which reached this requirement; Table II had 16 out of 28, but they were based upon the findings of only 3 studies; Table V had 11 out of 15, all based upon the work of Ross; and Table VI which contained the findings of Hooks had none. These results were based upon a study of 82 pupils.

The next chapter contains the treatment of the data of this thesis. Coefficients of correlation will be computed between intelligence quotients and the grades earned in specific subjects in the first year of high school; between eighth grade marks and the grades received in each of the subjects taught in the first year of high school; between intelligence

quotients and the grades earned in specific subjects in each of the three upper years in high school; and between the marks earned in specific subjects in each of the three upper years with the grades received in specific subjects in the previous year.

It is hoped that the findings will help to answer these questions: which are better, intelligence quotients or eighth grade marks, for predicting achievement in the ninth grade? which are better, intelligence quotients or the previous year's marks, for predicting achievement in the three upper years in high school?

CHAPTER III

THE ORIGINAL DATA

This chapter contains the basic material of the thesis. Coefficients of correlation have been computed between intelligence quotients and achievement in the various high school subjects offered in each of the four years, between eighth grade marks and achievement in the first year of high school, and between achievement in each of the three upper years and achievement in the previous year. These coefficients of correlation were computed in an effort to determine whether intelligence quotients or past school records were better bases by which to predict achievement in high school subjects.

On March 19, 1934, the Terman Group Test of Intelligence, Form A, was administered by Dr. James A. Fitzgerald of Loyola University, Chicago, Illinois, to 397 students of Loyola Academy, a private secondary school for boys. The number of pupils taking the intelligence examination in each of the four years comprising the senior high school level was as follows: first year, 120 pupils; second year, 109 pupils;third year, 103 pupils; and fourth year, 65 pupils.

The chronological age given by each student on his intelligence test paper was checked with his age as recorded on his permanent record card in the office records of Loyola Academy. The purpose of this procedure

was to promote accuracy in finding each student's intelligence quotient.

The high school achievement of each pupil as measured by teachers' marks was secured from the permanent records kept in the Academy office.

The eighth grade scholastic records of the first year high school pupils were taken from the official report cards which each of the students received monthly during his eighth grade work.

In each correlation only those cases which represented grades earned at Loyola Academy were included. Cases representing grades earned in other high schools were not included in the correlations to be reported in this chapter in order to eliminate, if possible, some of the variability present in teachers' marks.

If a student repeated a course, the grade he received the first time was used for correlation purposes because it seemed fair to assume that the first mark, rather than the second, was a better index of his ability to master a study.

The intelligence quotient of each pupil was computed according to the method contained in the Manual of Directions which accompanies the Terman Group Test of Mental Ability (28:10-11).

The following computations were necessary to obtain the intelligence quotient of each pupil. The example of student A, a freshman at Loyola Academy, will be studied.

The first step was to correct student A's intelligence test paper. Each test paper for Form A of the Terman Group Test of Mental Ability contains ten separate tests. The total score made on Form A of the Terman

Test is derived by adding the scores made on the ten individual tests. Student A received the following scores:

Test	Name	Score
1	INFORMATION	9
2	BEST ANSWER	22
3	WORD MEANING	14
4	LOGICAL SELECTION	16
5	ARITHMETIC	12
6	SENTENCE MEANING	14
7	ANALOGIES	18
8	MIXED SENTENCES	11
9	CLASSIFICATION	12
10	NUMBER SERIES	18
Total		146

The next step was to check the date of birth given by student A on his test paper with the one recorded on his permanent record card in the office of Loyola Academy.

If the date of birth given by a pupil on his intelligence test paper did not agree with the one recorded on his permanent card in the office file, the latter was taken arbitrarily as the true one because it was secured under ordinary classroom conditions during the previous September.

Student A wrote 'Nov. 25, 1933' in the space reserved for the date of birth on the intelligence test paper. The year was incorrect, so the date was taken from the school file. According to the office record

Student A was born on Nov. 25, 1919.

The life age of student A on March 19, 1934, the day on which the intelligence test was administered, was determined by subtracting the date of birth from March 19, 1934. This procedure indicated that student A was 14 years and 3 months of age when he was given the Terman Group Test of Mental Ability. Expressed in months the life age of student A was 171 months.

Page ten of the Manual of Directions was consulted in order to secure the mental age equivalent of the score made by student A. The table containing the mental age equivalents revealed that the mental age for a score of 146 was 203 months. The formula used for obtaining the intelligence quotient was:

$$\frac{\text{Mental Age}}{\text{Chronological Age}} \times \frac{100}{1} = \text{Intelligence Quotient}$$

By substituting the quantities already obtained about student A the formula became:

$$\frac{203}{171} \times \frac{100}{1} = 118 \text{ or the intelligence quotient of student A.}$$

The same procedure was followed for each pupil in order to obtain his intelligence quotient.

Each coefficient of correlation was computed on a Ruch-Stoddard Correlation Chart. These charts were obtained from the University of Iowa Bookstore, Iowa City, Iowa. These forms were used in order to promote accuracy and to save time.

Each chart contained spaces for the class intervals on the X and Y scales. Columns were also supplied for the computation of 'f', the frequency; 'd', the deviation; 'y', or 'fd', the frequency times the deviation; 'y^2', or the frequency times the deviation squared; and 'xy', the product-moment in each cell. The value of 'r' was derived from a formula containing the mathematical results secured from the last five columns. The formula was:

$$r = \frac{\frac{\Sigma xy}{N} - \left(\frac{\Sigma x}{N} \cdot \frac{\Sigma y}{N}\right)}{\sqrt{\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2}\sqrt{\frac{\Sigma y^2}{N} - \left(\frac{\Sigma y}{N}\right)^2}}$$

'N' referred to the number of cases contained in the correlation.

The probable error of the coefficient of correlation was computed from the following formula:

$$P.E._r = .6745 \frac{1 - r^2}{\sqrt{N}}$$

All the data necessary to find the probable error of each coefficient of correlation was taken directly from each Ruch-Stoddard Correlation Chart.

The coefficients of correlation for each of the four years will be treated in separate sections of the remainder of this chapter.

Findings

1. First Year Correlations

A. Intelligence Quotients Correlated with Achievement in First Year High School Subjects

The intelligence quotients of the first year high school pupils in Loyola Academy were correlated separately with their achievement in algebra, English, ancient history, Latin, and a composite of the average marks they earned in algebra, English, ancient history, and Latin. These coefficients of correlation are contained in Table VII.

The highest coefficient of correlation was obtained between intelligence quotients and achievement in English. The value of the coefficient was .570±.042. The lowest coefficient of correlation was obtained between intelligence quotients and the marks received in ancient history. The value of the coefficient was .440±.050. The ancient history marks for the four first year classes were given by two teachers. The English grades for the same classes were given by four teachers among whom were the two who taught ancient history. Teacher A had one group for both English and ancient history and Teacher B had another group for both English and ancient history. These two teachers have not given high marks, on the whole, during their past three years at Loyola Academy. Perhaps the comparatively low grades given by teachers A and B help to explain the difference in the values of the coefficients of correlation

between intelligence quotients and achievement in ancient history.

The value of the coefficients of correlation between intelligence quotients and achievement in algebra was .515±.045. The coefficient of correlation between intelligence quotients and the grades earned in first year Latin was .525±.045. Teacher C had the same group for algebra and Latin; teacher D had another group for both algebra and Latin; and teacher E had a third group for both algebra and Latin. The last division of first year had a different teacher for Latin and mathematics. The coefficients of correlation between intelligence quotients and algebra marks and between intelligence quotients and Latin marks were almost equal in value.

The coefficients of correlation in Table VII, column 2, between intelligence quotients and achievement in first year high school subjects were higher than those contained in Table II, column 2, between intelligence and achievement in algebra, English, history and Latin in the first year of high school as reported in six studies. In Table II the values of the coefficients of correlation between intelligence and achievement in algebra ranged from .12 to .42.

The two coefficients of correlation reported by Schmitz (24,25) in Table II between intelligence quotients and achievement in algebra may be compared to the coefficients of correlation obtained between intelligence quotients and algebra marks in Table VII. The coefficients of correlation computed by Schmitz were based upon the grades earned by boys alone in first year algebra. In the first correlation obtained by Schmitz (24) the value of the coefficient of correlation was .37, based upon 75 cases.

TABLE VII

Correlation between Intelligence Quotients and Achievement in First Year Subjects at Loyola Academy

(1) Subject	(2) r	(3) P.E.	(4) No.of Cases	(5) Test Used
English	.570	.042	120	Terman, Form A
Composite of algebra, English, ancient history, and Latin	.557	.043	116	Terman, Form A
Latin	.525	.045	117	Terman, Form A
Algebra	.515	.045	120	Terman, Form A
Ancient history	.440	.050	119	Terman, Form A

The second coefficient of correlation in Schmitz (25) was .12, based upon 528 cases. The coefficient of correlation in Table VII, column 2, between intelligence quotients and achievement in algebra at Loyola Academy was .515±.045, based upon 120 cases. Schmitz did not attempt to explain the difference between the values of his coefficients of correlation. Schmitz said (24:60):

> The agreement of the correlations in the earlier study with the present findings is fairly close with the single exception of that in Algebra. Here the correlation is so low as to render it practically useless. In fact, it is the lowest correlation I have ever observed between any phase of Mathematics and I Q. In this particular case, the calculation was doubly checked. Possible explanations for this descrepancy (sic) might be offered, but I feel that mere speculation would be futile.

A difference existed also in the value of the coefficients of correlation obtained by Schmitz (24,25) between intelligence quotients and achievement in algebra as reported in Table II, column 2, and between intelligence quotients and achievement in algebra at Loyola Academy as reported in Table VII, column 2. The values of the coefficients of correlation reported by Schmitz (24,25) were .37 and .123, based upon 75 and 528 cases, respectively. The coefficient obtained at Loyola Academy was .515±.045, based upon 120 cases. From the data at hand it did not seem possible to give a valud explanation.

The value of the coefficient of correlation between intelligence quotients and first year English grades are reported in Table VII, column 2, as .570±.042, based upon 120 cases. In Table II, column 2, the

the coefficients of correlation between intelligence and achievement in English ranged from .28 to .29. A difference was noted upon comparing the two coefficients obtained by Schmitz (24,25) in Table II, column 2, with the one contained in Table VII, column 2, between intelligence quotients and achievement in ninth grade English at Loyola Academy. Perhaps the cause of the difference was the same as the one existing for the coefficient of correlation between intelligence and achievement in algebra, but the reason was not evident from the coefficients themselves.

The differences of the coefficients of correlation between intelligence and achievement in algebra and between intelligence and achievement in English as noted in Table II, column 2, and Table VII, column 2, were present also in the coefficients of correlation reported in Table II, column 2, and Table VII, column 2, between intelligence quotients and achievement in history and between intelligence quotients and achievement in Latin. In Table II, column 2, the coefficients of correlation between intelligence and achievement in history ranged from .26 to .44. In Table VII, column 2, the coefficient of correlation between intelligence quotients and achievement in first year history at Loyola Academy was .440± .050.

The coefficient of correlation reported by Schmitz (24) in Table II, column 2, between intelligence and achievement in history was .43 based upon 525 cases. The coefficient of correlation reported in Table VII, column 2, between intelligence quotients and achievement in ancient history at Loyola Academy was .440±.050, based upon 120 cases. These two

coefficients of correlation were similar in value and it seemed reasonable to assume that the coefficient of .440±.050 represented the degree of relationship between intelligence quotients and the grades earned in ancient history at Loyola Academy.

Table II, column 2, showed that the coefficient of correlation between intelligence and achievement in first year Latin ranged from .18 to .50. One coefficient of correlation reported by Schmitz (24), the value of which was .50, based upon 79 cases, agreed numerically with the coefficient of correlation obtained at Loyola Academy between intelligence quotients and achievement in first year Latin. The value of this coefficient as reported in Table VII, column 2, was .525±.045, based upon 117 cases.

The coefficients of correlation in Table VII were not compared separately with the remaining coefficients in Table II because the latter coefficients were based upon studies made from cases secured from public high schools.

B. Achievement in Eight Grade Subjects Correlated with Achievement in First Year High School Subjects

The grades earned in each subject taught in the first year at Loyola Academy were correlated with the marks earned in eighth grade studies. The following coefficients of correlation were computed: algebra with eighth grade arithmetic; English with eighth grade English; ancient history with eighth grade history; Latin with eighth grade English; and a

composite of average achievement in algebra, English, ancient history, and Latin with an eighth grade composite of average achievement in arithmetic, English, history, reading, and spelling.

The highest coefficient of correlation reported in Table VIII, column 3, was the one obtained between the two composites. The composite of average achievement in first year algebra, English, ancient history, and Latin was correlated with a composite of the average achievement in eighth grade arithmetic, English, history, reading, and spelling. The value of the coefficient of correlation was .525±.045. The next highest ranking coefficient of correlation was the one obtained between achievement in ancient history and in eighth grade history. The coefficient was .513±.046. The value of the coefficient of correlation between achievement in first year English and eighth grade English was .483±.047; that between achievement in algebra and eighth grade arithmetic was .466±.049; that between achievement in Latin and eighth grade English was .392±.053.

The coefficients of correlation in Table VII, column 2, between intelligence quotients and achievement in the first year subjects at Loyola Academy ranged from .440±.050 to .570±.042. In Table VIII, column 3, the coefficients of correlation between achievement in eighth grade subjects and in first year studies in high school ranged from .392±.053 to .525±.045.

The studies reported by Schmitz (24,25) in Chapter II were the only ones found relating to the correlation between intelligence quotients and achievement in a private high school for boys. However, he did not corre-

late achievement in the ninth grade with achievement in the eighth grade. Schmitz reported the coefficients of correlation he found in two studies. In the first study Schmitz (24) found the following coefficients: that between intelligence quotients and achievement in ninth grade algebra was .37, based upon 79 cases; that between intelligence quotients and achievement in ninth grade English was .49, based upon 79 cases; and that between intelligence quotients and achievement in ninth grade Latin was .50, based upon 79 cases. In the second study Schmitz (25) found the following coefficients of correlation: that between intelligence quotients and achievement in ninth grade algebra was .123, based upon 528 cases; that between intelligence quotients and achievement in ninth grade English was .33, based upon 529 cases; that between intelligence quotients and achievement in ninth grade history was .435, based upon 525 cases; and that between intelligence quotients and achievement in ninth grade Latin was .33, based upon 516 cases.

Hooks (13) obtained the following coefficients of correlation between intelligence quotients and achievement in the ninth grade: that between intelligence quotients and achievement in algebra was .31±.0677, based upon 82 cases; that between intelligence quotients and achievement in English was .42±.0571, based upon 82 cases; and that between intelligence quotients and achievement in Latin was .33±.0677. Hooks (13) found the following coefficients of correlation between achievement in grade school subjects and achievement in ninth grade subjects: that between achievement in a grade school composite of age at end of grade 8; English, grades 4-6;

TABLE VIII

Correlation between Achievement in the Eighth Grade and in the First Year at Loyola Academy

(1) First Year Subject	(2) Grade School Composite	(3) r	(4) P.E.	(5) No.of Cases
Composite of algebra, English, ancient history, and Latin	*	.525	.045	117
Ancient history	**	.513	.046	119
English	***	.483	.047	119
Algebra	****	.466	.049	118
Latin	*****	.392	.053	117

* The composite of average achievement in the first year of high school was correlated with a composite of the average achievement in eighth grade arithmetic, English, history, reading, and spelling.

** Achievement in ancient history was correlated with achievement in eighth grade history.

*** Achievement in first year high school English was correlated with achievement in eighth grade English.

**** Achievement in algebra was correlated with achievement in eighth grade arithmetic.

***** Achievement in Latin was correlated with achievement in eighth grade English.

English, grades 7-8; and achievement in ninth grade English was .67±.0426, based upon 82 cases; that between achievement in a grade school composite of age at end of grade 8; grade progress; English, grades 7-8; arithmetic, grades 7-8; history, grades 5-6; days present, grades 2-3; and days present, grades 4-6 and achievement in ninth grade Latin was .55±.0534, based upon 82 cases; and that between achievement in a grade schoom composite of grade progress; English, grades 4-6; arithmetic, grades 7-8; and days present, grades 2-3 and achievement in ninth grade mathematics was .43±.0621, based upon 82 cases.

Correlations were computed between intelligence quotients and achievement in first year high school subjects and between achievement in eighth grade studies and in first year high school subjects in an effort to find the better method of the two in predicting group achievement in first year algebra, English, ancient history, and Latin. Upon comparing the coefficients of correlation in Table VII, column 2, with those in Table VIII, column 3, it seemed safe to state the following conclusions: (1) algebra achievement may be predicted about as well from eighth grade arithmetic marks as from intelligence quotients. The coefficients of correlation were .466±.049 and 515±.045, respectively; (2) English achievement may be predicted better from intelligence quotients than from eighth grade English marks. The coefficients of correlation were .570±.042 and .483±.047, respectively; (3) ancient history achievement may be predicted better from eighth grade history marks than from intelligence quotients. The coefficients of correlation were .513±.046 and .440±.050, respectively;

(4) Latin achievement may be predicted better from intelligence quotients than from eighth grade English marks. The coefficients of correlation were .525±.045 and .392±053, respectively.

In order to have a standard by which to judge the usefulness of a coefficient of correlation the opinions of Chaddock (3), Good (9), Holzinger (12), and Odell (18) were expressed in Chapter II. It seemed fair to say they agreed that a coefficient of correlation to be useful for prediction may be as low as .5, provided the probable error is small. Applying this criterion of usefulness to the coefficients of correlation reported in Table VII and in Table VIII it is noted that the one accepted as the better indicator of achievement in each subject was above .5, had a small probable error, and was based upon 117 or more cases. These coefficients of correlation may prove useful in predicting group achievement but, for individual cases, the regression equations must be used.

2. Second Year Correlations

A. Intelligence Quotients Correlated with Achievement in Second Year High School Subjects

The intelligence quotients of the second year students were correlated separately with the marks they earned in civics, English, plane geometry, American History, Latin, and a composite of the average grades they received in civics, English, plane geometry, American History, and Latin. Table IX contains these coefficients of correlation.

Civics and American History correlated the highest with intelligence quotients. The coefficients of correlation were .607±.042 and .581±.044, respectively. American History was taught the first semester and civics the second semester. The same teacher conducted all the classes in both studies. The same students, with five exceptions, studied both American History and civics. These two conditions, the same teacher for all classes in both subjects and the same student enrollment, with five exceptions, may account for both coefficients of correlation being high and for both being about the same in value.

The coefficient of correlation between the composite of the average grades earned in civids, English, plane geometry, American History, and Latin was .501±.047. The coefficients of correlation between intelligence quotients and achievement in English and between intelligence quotients and achievement in Latin were not as high as the three previous coefficients. The values of the last two coefficients of correlation were.499±.049 and .420±.055, respectively. The four second year English classes and the four second year Latin classes were divided between two teachers. Teacher A had two groups for both English and Latin and Teacher B had the remaining two groups for both English and Latin. The same pupils, with few exceptions, studied civics, English, American History, and Latin. The coefficients of correlation between intelligence quotients and achievement in civics and between intelligence quotients and achievement in American History were about equal to those obtained between intelligence quotients and achievement in English and between intelligence quotients and achievement in Latin.

TABLE IX

Correlation between Intelligence Quotients and Achievement in Second Year Subjects at Loyola Academy

(1) Subject	(2) r	(3) P.E.	(4) No. of Cases	(5) Test Used
American History	.607	.042	105	Terman, Form A
Civics	.581	.044	103	Terman, Form A
Composite of civics, English, plane geometry, American History, and Latin	.501	.047	95	Terman, Form A
English	.499	.049	108	Terman, Form A
Latin	.420	.055	101	Terman, Form A
Plane geometry	.406	.056	102	Terman, Form A

The coefficient of correlation obtained between intelligence quotients and achievement in plane geometry was .406±.056. The second year mathematics grades were given by three teachers and this may explain, in part, why the coefficient of correlation between intelligence quotients and achievement in plane geometry was the lowest in the group reported in Table IX.

B. Achievement in First Year High School Subjects Correlated with Achievement in Second Year High School Subjects

The achievement in each of the studies taught in the tenth grade was correlated with the achievement in a first year study. The following coefficients of correlation were computed: first year English with second year English; algebra with plane geometry; ancient history with American History; first year Latin with second year Latin; and a composite of average achievement in first year algebra, English, ancient history, and Latin with a composite of average achievement in second year civics, English, plane geometry, American History, and Latin. These coefficients of correlation are contained in Table X.

The coefficient of correlation between the composite of the average grades earned in first year and the composite of the average grades earned in second year was .842±.022. Apparently, achievement in first year was closely related to achievement in second year because the coefficient of correlation, .842±.022, was high as considered by many statisticians; the marks were assigned by many teachers; and a fairly large number of

cases was used. The coefficient of correlation between achievement in ancient history and in American History was .798±.025. These two subjects were taught by different teachers, so this may add to the usefulness of the coefficient. The coefficient of correlation between achievement in first year Latin and in second year Latin was .788±.028. Apparently there was a close relationship between achievement in first year Latin and in second year Latin. The coefficient of correlation between achievement in first year English and in second year English was .700±.036. Perhaps, as in Latin, the relationship between achievement in English in the ninth and tenth grades was more significant because several teachers' marks were included. The lowest coefficient of correlation was obtained between the grades received in first year algebra and in plane geometry. The coefficient was .601±.046. However, this value of the coefficient of correlation seemed to indicate that it was useful for predicting group achievement in plane geometry because it was above the standard of .5 agreed upon by Chaddock (3), Good (9), Holzinger (12), and Odell (18) as the lowest value of a coefficient of correlation to be accepted for a useful predictive measure; the grades were given by several teachers; and the coefficient of correlation was based upon 89 cases.

Upon comparing Table IX and Table X which contained the coefficients of correlation for second year it seemed that these conclusions were warranted: (1) English achievement may be predicted better from achievement in first year English than from intelligence quotients. The coefficients of correlation were .700±.036 and .471±.051, respectively;

TABLE X

Correlation between Achievement in First Year Subjects and in Second Year Subjects at Loyola Academy

(1) Second Year Subject	(2) First Year Composite	(3) r	(4) P.E.	(5) No.of Cases
Composite of civics, English, plane geometry, American History, and Latin	*	.842	.022	83
American History	**	.798	.025	94
Latin	***	.788	.028	86
English	****	.700	.036	93
Plane geometry	*****	.601	.046	89

* The composite of average achievement in the second year of high school was correlated with a composite of the average achievement in first year algebra, English, ancient history, and Latin.

** Achievement in American History was correlated with achievement in ancient history.

***Achievement in Latin was correlated with achievement in first year Latin.

****Achievement in English was correlated with achievement in first year English

*****Achievement in plane geometry was correlated with achievement in first year algebra.

(2) plane geometry achievement may be predicted better from achievement in first year algebra than from intelligence quotients. The coefficients of correlation were .607±.045 and .406±.056, respectively; (3) American History achievement may be predicted better from achievement in ancient history than from intelligence quotients. The coefficients of correlation were .798±.025 and .607±.042, respectively; (4) Latin achievement may be predicted better from achievement in first year Latin than from intelligence quotients. The coefficients of correlation were .788±.028 and .420±.055, respectively.

The coefficients of correlation, which seemed to be the better criteria of achievement, were above .6 in value. It seemed safe to accept these coefficients as useful for predicting group achievement in each of the studies offered in the tenth grade because they were above the minimum standard of usefulness agreed upon by authorities in the field of statistics and were based upon large numbers of cases.

3. Third Year Correlations

A. Intelligence Quotients Correlated with Achievement in Third Year High School Subjects

The intelligence quotients of the third year pupils were correlated separately with achievement in advanced algebra, chemistry, English, French, solid geometry, Latin, and a composite of average achievement in advanced algebra, English, solid geometry, and Latin. These coefficients of correlation are contained in Table XI.

TABLE XI

Correlation between Intelligence Quotients and Achievement in Third Year Subjects at Loyola Academy

(1) Subject	(2) r	(3) P.E.	(4) No.of Cases	(5) Test Used
Solid geometry	.409	.071	63	Terman, Form A
Advanced algebra	.393	.073	62	Terman, Form A
Latin	.376	.065	80	Terman, Form A
Composite of advanced algebra, English, solid geometry, and Latin	.368	.079	55	Terman, Form A
English	.319	.062	96	Terman, Form A
Chemistry	.288	.108	33	Terman, Form A
French	.273	.081	59	Terman, Form A

The highest coefficients of correlation reported in Table XI were those found for solid geometry and advanced algebra. The values of these coefficients were .409±.071 and .393±.073 respectively. The use of these coefficients of correlation to predict group achievement in these two subjects was doubtful because they were low in value and were based upon small numbers of cases.

The use of intelligence quotients to predict group achievement in third year English and Latin did not yield high coefficients of correlation. The values of the coefficients were .319±.062 and .376±.065, respectively.

The coefficient of correlation between intelligence quotients and achievement in chemistry was very low. Only 33 pupils had credit in both semesters of chemistry, so this may account for the low value of the coefficient, 288±.108.

The coefficients of correlation between intelligence quotients and achievement in French and between intelligence quotients and a composite of the average achievement in advanced algebra, English, solid geometry, and Latin were also low. The coefficients were .273±.081 and .368±.079, respectively.

B. Achievement in Second Year High School Subjects Correlated with Achievement in Third Year High School Subjects

In this set of coefficients of correlation chemistry was not included because the number of pupils with two semester's credit in the subject was too small to obtain useful results. The following coefficients of correlation were computed: plane geometry with advanced algebra; plane geometry with solid geometry; second year English with third year English; second year Latin with third year Latin; and a composite of the average achievement in second year civics, English, plane geometry, American History, and Latin with a third year composite of the average achievement in advanced algebra, English, solid geometry, and Latin. These coefficients of correlation are obtained in Table XII.

The highest coefficient of correlation was obtained between the two composites. As in the case of the average achievement in first year correlated with the average achievement in second year reported in Table X, column 3, it seemed there was a similar close relationship between the average achievement in second year and the average achievement in third year. However, only 52 cases were considered in the latter coefficient of correlation.

The coefficient of correlation between achievement in advanced algebra and in plane geometry was .764±.036 and the value of the coefficient between achievement in solid geometry and plane geometry was .718±.040. Only 61 and 67 cases, respectively, were used in these two coefficients of

correlation. The probable errors were small, ±.036 and ±.040, respectively. Apparently there was a close relationship between the grades earned in second and third year mathematics.

The coefficients of correlation between achievement in second and third year Latin and between achievement in second and third year English were high also. The coefficients were .731±.036 and .684±.038, respectively. The number of cases was rather small in both coefficients of correlation; for Latin, 78 cases were considered and for English, 88 cases. It may be fair to assume that there was a close relationship between group achievement in second year Latin and in third year Latin, and between achievement in second year English and in third year English.

TABLE XII

Correlation between Achievement in Second Year Subjects and in third Year Subjects at the Loyola Academy

(1) Third Year Subject	(2) Second Year Composite	(3) r	(4) P.E.	(5) No.of Cases
Composite of advanced algebra, English, solid geometry, and Latin	*	.789	.035	52
Advanced algebra	**	.764	.036	61
Latin	***	.731	.036	78
Solid geometry	****	.718	.040	67
English	*****	.684	.038	88

* The composite of average achievement in third year advanced algebra, English, solid geometry, and Latin was correlated with a composite of average achievement in second year civics, English, plane geometry, American History, and Latin.

** Achievement in advanced algebra was correlated with achievement in plane geometry.

*** Achievement in Latin was correlated with achievement in second year Latin.

**** Achievement in solid geometry was correlated with achievement in plane geometry.

***** Achievement in English was correlated with achievement in second year English.

4. Fourth Year Correlations

A. Intelligence Quotients Correlated with Achievement in Fourth Year High School Subjects

The intelligence quotients of the fourth year students were correlated separately with achievement in English, Latin, physics, and a composite of the average achievement in English, Latin, and physics. These coefficients of correlation are contained in Table XIII. Coefficients were not computed between intelligence quotients and achievement in a modern language, French, Greek, or Spanish, and modern history because the number of cases in each subject was less than 35.

The highest coefficient of correlation was obtained between intelligence quotients and achievement in English. The value of the coefficient was .535±.060. This coefficient of correlation did not seem useful for the prediction of group achievement in English because it was only slightly above .5, the point which Chaddock (3), Good (9), Holzinger (12), and Odell (18) apparently agreed upon as a minimum value for a useful coefficient of correlation for prediction and the number of cases was small. The remaining coefficients of correlation reported in Table XIII between intelligence quotients and achievement in Latin, physics, and a composite of the average achievement in English, Latin, and physics were low in value and were based upon small numbers of cases. The presence of these two conditions made the coefficients of correlation impractical for the prediction of group achievement.

TABLE XIII

Correlation between Intelligence Quotients and Achievement in Fourth Year Subjects at Loyola Academy

(1) Subject	(2) r	(3) P.E.	(4) No.of Cases	(5) Test Used
English	.535	.060	65	Terman, Form A
Physics	.430	.076	52	Terman, Form A
Latin	.369	.091	42	Terman, Form A
Composite of English, Latin and physics	.339	.109	35	Terman, Form A

B. Achievement in Third Year High School Subjects Correlated with Achievement in Fourth Year High School Subjects

The coefficients of correlation computed in this group were as follows: third year English with fourth year English; third year Latin with fourth year Latin; the average achievement in first year algebra and second year plane geometry with physics; and a composite of the average achievement in third year English and Latin with a composite of the average achievement in third year English and Latin with a composite of the average achievement in fourth year English, Latin, and physics. The highest coefficient of correlation was found between third year English and fourth year English. The value of the coefficient was .874±.024. The remaining coefficients of correlation were based upon small numbers of cases ranging from 35 to 42 and, therefore, were not considered valuable for prediction purposes. It seemed safe to assume that the only useful coefficients of correlation for group achievement in fourth year were those for English. Of the two coefficients of correlation for English, the one between achievement in third year English and achievement in fourth year English appeared to be the better indicator of group achievement because the coefficient was higher in value.

General Conclusions

The coefficients of correlation between intelligence quotients and achievement in each of the four years of high school and between achievement in each of the four years with achievement in the previous year seemed to warrant these general conclusions:

1. Eighth grade marks were about as useful as intelligence quotients for predicting group achievement in first year.

A. The coefficient of correlation between intelligence quotients and achievement in algebra was .515±.045, based upon 120 cases; that between achievement in eighth grade arithmetic and algebra was .466±.049, based upon 118 cases.

B. The coefficient of correlation between intelligence quotients and achievement in English was .570±.042, based upon 120 cases; that between eighth grade English and first year high school English was .483±.047, based upon 119 cases.

C. The coefficient of correlation between achievement in eighth grade history and ancient history was .513±.046, based upon 119 cases; that between intelligence quotients and achievement in ancient history was .440±.050, based upon 119 cases.

D. The coefficient of correlation between intelligence quotients and achievement in Latin was .525±.045, based upon 117 cases; that between eighth grade English and achievement in Latin was .392±.053, based upon 117

TABLE XIV

Correlation between Achievement in Third Year Subjects and in Fourth Year Subjects at Loyola Academy

(1) Fourth Year Subject	(2) Third Year Composite	(3) r	(4) P.E.	(5) No.of Cases
English	*	.847	.024	65
Composite of English, Latin, and physics	**	.835	.035	35
Latin	***	.754	.045	42
Physics	****	.648	.060	42

* Achievement in English was correlated with achievement in third year English.

** The composite of average achievement in fourth year English, Latin, and physics was correlated with a composite of average achievement in third year English and Latin.

*** Achievement in Latin was correlated with achievement in third year Latin.

**** Achievement in physics was correlated with a composite of average achievement in first year algebra and in second year plane geometry.

cases.

E. The coefficient of correlation between intelligence quotients and a composite of the average achievement in algebra, English, ancient history, and Latin was .557±.043, based upon 116 cases; that between a composite of the average achievement in eighth grade arithmetic, English, history, reading, and spelling and a composite of the average achievement in algebra, English, ancient history, and Latin was .525±.045, based upon 117 cases.

2. The marks earned in the first year of high school were more useful for predicting group achievement in the second year than were intelligence quotients.

A. The coefficient of correlation between achievement in first year English and in second year English was .700±.036, based upon 93 cases; that between intelligence quotients and achievement in second year English was .499±.049, based upon 108 cases.

B. The coefficient of correlation between achievement in algebra and in plane geometry was .601±.046, based upon 89 cases; that between intelligence quotients and achievement in plane geometry was .406±.056, based upon 102 cases.

C. The coefficient of correlation between achievement in ancient history and in American History was .798±.025, based upon 94 cases; that between intelligence quotients and achievement in American History was .607±.042, based upon 105 cases.

D. The coefficient of correlation between achievement in first year Latin and in second year Latin was .788±.028, based upon 86 cases; that between intelligence quotients and achievement in second year Latin was .420±.055, based upon 101 cases.

E. The coefficient of correlation between a composite of the average achievement in first year algebra, English, ancient history, and Latin and a composite of the average achievement in second year civics, English, plane geometry, American History, and Latin was .842±.022, based upon 83 cases; that between intelligence quotients and a composite of the average achievement in second year civics, English, plane geometry, American History, and Latin was .501±.047, based upon 95 cases.

3. The marks earned in the second year of high school were more useful for predicting group achievement in the third year than were intelligence quotients. However, these coefficients of correlation were based upon small numbers of cases.

A. The coefficient of correlation between achievement in plane geometry and in advanced algebra was .764±.036, based upon 61 cases; that between intelligence quotients and achievement in advanced algebra was .393±.073, based upon 62 cases.

B. The coefficient of correlation between achievement in second year English and in third year English was .684±.038, based upon 88 cases; that between intelligence quotients and achievement in third year English was .319±.062, based upon 96 cases.

C. The coefficient of correlation between achievement in plane geometry and in solid geometry was .718±.040, based upon 67 cases; that between intelligence quotients and achievement in solid geometry was .409±.071, based upon 63 cases.

D. The coefficient of correlation between achievement in second year Latin and in third year Latin was .731±.036, based upon 78 cases; that between intelligence quotients and achievement in third year Latin was .376±.065, based upon 80 cases.

E. The coefficient of correlation between a composite of the average achievement in second year civics, English, plane geometry, American History, and Latin and a composite of the average achievement in third year advanced algebra, English, solid geometry, and Latin was .789±.035, based upon 52 cases; that between intelligence quotients and a composite of the average achievement in advanced algebra, English, solid geometry and Latin was .368±.079, based upon 55 cases.

4. The coefficients of correlation in fourth year, although high, were not useful for the prediction of group achievement because they were based upon small numbers of cases.

A. The coefficient of correlation between achievement in third year English and in fourth year English was .847±.024, based upon 65 cases; that between intelligence quotients and achievement in fourth year English was .533±.060, based upon 65 cases.

B. The coefficient of correlation between achievement in third year Latin and in fourth year Latin was .754±.045; that between

intelligence quotients and achievement in fourth year Latin was .369±.091, based upon 42 cases.

C. The coefficient of correlation between a composite of the average achievement in elementary algebra and plane geometry and achievement in physics was .648±.060, based upon 42 cases; that between intelligence quotients and achievement in physics was .430±.076, based upon 52 cases.

D. The coefficient of correlation between a composite of the average achievement in third year English and Latin and a composite of the average achievement in fourth year English, Latin, and physics was .835±.035, based upon 35 cases; that between intelligence quotients and a composite of the average achievement in fourth year English, Latin, and physics was .339±.109, based upon 35 cases.

5. There is a need for further research in the prediction of group achievement in private secondary schools before any significance can be attached to the tentative conclusions stated in this thesis.

CHAPTER IV

THE PREDICTION OF SUCCESS IN HIGH SCHOOL SUBJECTS

The purpose of this chapter is to show how scholastic success in Loyola Academy may be predicted for individuals by the use of the regression equations. The subjects for which success is predicted are first year algebra, English, history, and Latin. The work of predicting success in the subjects offered in the upper years of Loyola Academy is not included in this chapter because of the small number of cases upon which many of the coefficients of correlation are based and because of the great labor of calculation. However, an example in connection with American History is presented in order to illustrate the results with a fairly high coefficient of correlation.

The questions of specific importance to be answered in this chapter are: (1) what intelligence quotient is necessary in a pupil so that it is possible to predict that he will be successful within limits in obtaining a passing grade (70 or better) in ninth grade subjects? (2) what grade in a specific subject in the previous year is necessary in order that success in algebra, English, history, and Latin by a particular student may be predicted within limits? The regression equations as set forth in Lindquist and Stoddard's Study Manual in Elementary Statistics (16:65) are used in making these calculations of prediction.

The equation for Y is used to predict success in first year algebra, English, history, and Latin when the predicted grade is based upon success in a study in the previous year. The terms in the equation for Y are as follows: Y is the predicted grade in a specific subject; 'r' is the coefficient of correlation between grades in a subject of the previous year and the subject for which it is desired to predict success; σ_x is the standard deviation of the obtained X scores (that is, the grades earned in a specific eighth grade subject which are plotted on the X axis); σ_y is the standard deviation of the obtained Y scores (that is, the grades earned in a specific first year subject which are plotted on the X axis); M_x is the actual mean of the grades or raw scores plotted on the X axis; and M_y is the actual mean of the grades or raw scores plotted on the Y axis.

1. Prediction of Success in First Year Algebra from Success in Eighth Grade Arithmetic and Intelligence Quotients

Table XV, column 2, contains the first year algebra grades predicted for students who attained specific degrees of success (that is, grades) in eighth grade arithmetic. An illustration of the way in which the predicted grades of column 2 in Table XV are obtained is given. The data

TABLE XV

Success in First Year Algebra Predicted from Success in Eighth Grade Arithmetic

(1) Grade in Eighth Grade Arithmetic	(2) Predicted Success in First Year Algebra* Y	(3) Chances Even that Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Pass
70	68.61 ± 7.16	61.45-75.77	-.19	55	45
75	71.89 ± 7.16	64.73-79.05	.26	44	56
80	75.14 ± 7.16	67.98-82.30	.71	32	68
85	78.41 ± 7.16	71.25-85.57	1.17	22	78
90	81.67 ± 7.16	74.51-88.83	1.62	14	86
95	84.93 ± 7.16	77.77-92.09	2.08	8	92

*The passing mark in Loyola Academy is 70.

taken from the correlation chart are: 'r' is the coefficient of correlation between achievement in eighth grade arithmetic and achievement in first year algebra for a group of 118 pupils of Loyola Academy in 1933-1934; σ_y is the standard deviation of these first year algebra grades plotted on Y axis; σ_x is the standard deviation of the eighth grade arithmetic grades plotted on the X axis; M_x is the actual mean of the eighth grade arithmetic grades plotted on the X axis; M_y is the actual mean of the first year algebra grades plotted on the Y axis; and X is a grade in eighth grade arithmetic from which success in first year algebra is predicted. Therefore

$$r = .466$$

$$\sigma_y = 4.01 \text{ (3, the class interval)} = 12.03$$

$$\sigma_x = 2,85 \text{ (3, the class interval)} = 8.55$$

$$M_x = 87.09$$

$$M_y = 79.77$$

$$X = 70$$

When these values are substituted in the equation it becomes:

$$Y = .466 \frac{12.03}{8.55} (X - 87.09) + 79.77$$

$$Y = .652X + 22.99$$

$$Y = .652 (70) + 22.99$$

$$Y = 68.61$$

The probable error for the equation for Y is computed according to the formula given by Lindquist and Stoddard (16:68). The formula follows:

$$P.E._{est.y} = .6745 \sigma_y \sqrt{1 - r^2}$$

By substituting the values obtained from the computation of the coefficient of correlation between achievement in eighth grade arithmetic and achievement in first year algebra the equation becomes:

$$P.E._{est.y} = .6745\ (12.03)\ \sqrt{1 - .217156}$$

$$P.E._{est.y} = \pm 7.16$$

The full value of Y becomes:

$$Y = 68.61 \pm 7.16$$

Therefore the chances are even that a pupil with a grade of 70 in eighth grade arithmetic will receive in first year algebra in Loyola Academy a grade between 61.45 and 75.77. According to the law of probabilities, however, such a pupil might receive a grade varying from this estimate as much as four probable errors or ± 28.64. Again, the predicted grade in algebra for a pupil with 75 in eighth grade arithmetic is 71.89±7.16. As reported in column 5, 44 percent of the pupils who receive 75 in eighth grade arithmetic will receive less than 70, the passing grade, in first year algebra. The following are the data showing the percentages of failure for the eighth grade arithmetic grades indicated: 85, 22 percent; 90, 14 percent; and 95, 8 percent.

The large probable error reported in Table XV, column 2, minimizes the usefulness of the eighth grade arithmetic grades as a means of predicting success in first year algebra in Loyola Academy.

Table XVI, column 2, contains the first year algebra grades predicted from intelligence quotients. An example of the way in which the predicted

grades in column 2 in Table XVI are obtained is given. The data taken from the correlation chart are: 'r' is the coefficient of correlation between intelligence quotients and achievement in first year algebra for 118 pupils in Loyola Academy; σ_y is the standard deviation of the intelligence quotients plotted on the Y axis; σ_x is the standard deviation of the first year algebra grades plotted on the X axis; M_y is the actual mean of the intelligence quotients plotted on the Y axis; M_x is the actual mean of the first year algebra grades plotted on the X axis; and Y is the intelligence quotient, for example, of an entering pupil for which success in first year algebra is predicted. Therefore

$$r = .515$$

$$\sigma_x = 2.41 \text{ (5, the class interval)} = 12.05$$

$$\sigma_y = 2.71 \text{ (5, the class interval)} = 13.55$$

$$M_y = 113.13$$

$$M_x = 78.92$$

$$Y = 90$$

When these values are substituted in the equation it becomes:

$$X = .515 \frac{12.05}{13.55} (Y - 113.13) + 78.92$$

$$X = .457Y + 27.22$$

$$X = .457 (90) + 27.22$$

$$X = 68.35$$

The probable error for the equation for X is computed according to the formula given by Lindquist and Stoddard (16:68). The formula follows:

$$P.E._{est.x} = .6745 \sigma_x \sqrt{1 - r^2}$$

TABLE XVI

Success in First Year Algebra Predicted from Intelligence Quotients

(1) Intelligence Quotients	(2) Predicted Success in First Year Algebra** X	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Fail	(5) Percent Will Pass
90	68.35±6.96	61.39-75.31	-.23	55	45
95	70.63±6.96	63.67-77.59	.09	48	52
100	72.92±6.96	65.96-79.88	.41	39	61
105	75.20±6.96	68.24-82.16	.74	32	68
110	77.49±6.96	70.53-84.45	1.07	24	76
115	79.78±6.96	72.82-86.74	1.40	17	83
120	82.06±6.96	75.10-89.02	1.87	10	90
125	84.34±6.96	77.38-91.30	2.06	8	92
130	86.63±6.96	79.67-93.59	2.38	6	94
135	88.94±6.96	81.98-95.90	2.71	3	97
140	91.23±6.96	84.27-98.19	3.05	2	98
145	93.52±6.96	86.56-100.48	3.37	1	99
150	95.81±6.96	88.85-102.77	3.70	1	99

* These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing mark in Loyola Academy is 70.

By substituting the values obtained from the computation of the coefficient of correlation between intelligence quotients and achievement in first year algebra the equation becomes:

$$P.E._{est.}x = .6745\ (12.05)\ \sqrt{1 - .265225}$$

$$P.E._{est.}x = \pm 6.96$$

The full value of X becomes:

$$X = 68.35 \pm 6.96$$

The degree of success in first year algebra in Loyola Academy predicted from intelligence quotients is shown in Table XVI. The Table is read as follows: the predicted grade for a pupil with an intelligence quotient of 90 is 68.35±6.96, slightly below the passing mark of 70. In column 3 it may be noted that the chances are even that the grade of a pupil with an intelligence quotient of 90 will lie between 61.39 and 75.31. In other words, 50 percent of the pupils with an intelligence quotient of 90 will receive grades between 61.39 and 75.31. Column 4 gives the algebraic quotient x divided by P.E. (x equals the best estimate of the grade minus the passing mark of 70. P.E. equals .6745 times the standard deviation of the distribution.) In this case the index equals -.23. A prepared table found in Holzinger's Statistical Methods for Students in Education (12:237) was used in finding the percentage of success in failure for different intelligence quotients reported in column 5. Forty eight percent of the pupils with an intelligence quotient of 95 will fair to receive a passing mark; 39 percent with an intelligence quotient of 100 will fair to pass. The following are the data showing the percentage of failure for the intelligence quotients indicated:

105, 32 percent; 110, 24 percent; 115, 17 percent; 120, 10 percent; 125, 8 percent; 130, 6 percent; 135, 3 percent; 140, 2 percent, 145, 1 percent; and 150, 1 percent.

The large probable error reported in Table XVI, column 2, limits accordingly the use of intelligence quotients in predicting success in first year algebra in Loyola Academy.

If column 2 in Table XV, showing the prediction of success in first year algebra from eighth grade arithmetic grades, is compared with column 2 in Table XVI, showing the prediction of success in first year algebra from intelligence quotients, it is noted that intelligence quotients seem to be more useful than eighth grade arithmetic grades, because the probable error in Table XVI is slightly less than the probable error reported in Table XV. Intelligence quotients are more practicable than eighth grade marks to predict success in first year algebra because intelligence quotients are easier to obtain and eighth grade report cards are not always available. Perhaps, for most purposes, there is very little difference in the degree of accuracy of the prediction of success in first year algebra from eighth grade arithmetic grades and from intelligence quotients.

2. Prediction of Success in First Year English from Success in Eighth Grade English and Intelligence Quotients

Table XVII, column 2, contains the first year English grades predicted from definite degrees of success in eighth grade English. The chances are even that a pupil with a grade of 70 in eighth grade English will receive in first year English in Loyola Academy a grade between 64.79 and 75.65. However, according to the law of probabilities such a student might receive a grade varying from this estimate as much as four probable errors or ± 21.72. The predicted grade in English for a pupil with 75 in eighth grade English is 73.36±5.43, that is, 35 percent of the pupils who receive 75 in eighth grade English will receive less than 70 in first year English. Twenty-two percent of the pupils who receive 80 in eighth grade English will attain a grade below the passing mark of 70. The following are the data showing the percentages of failure for the eighth grade English marks indicated: 85, 12 percent; 90, 6 percent; and 95, 2 percent.

The large probable error reported in Table XVII, column 2, restricts the usefulness of the eighth grade English grades as a means of predicting success in first year English in Loyola Academy.

The prediction of success in first year English from intelligence quotients is shown in Table XVIII. In column 3 it may be noted that the chances are even that the grade of a pupil with an intelligence quotient

of 90 will lie between 66.56 and 76.36. In other words, 50 percent of the pupils with an intelligence quotient of 90 will receive grades between 66.56 and 76.36. Column 5 indicates the percentage of success and failure for pupils with different intelligence quotients. The following are the data showing the percentages of failure for the intelligence quotients indicated: 90,44 percent; 95, 33 percent; 100, 25 percent; 105, 17 percent; 110, 12 percent; 115, 7 percent; 120, 5 percent; 125, 2 percent; 130, 1 percent; 135, 1 percent; 140, no failures; 145, no failures; and 150, no failures.

The large probable error reported in Table XVIII, column 2, limits the use of intelligence quotients in predicting success in first year English in Loyola Academy.

A higher probable error is reported in Table XVII, column 2, showing the prediction of success in first year English from eighth grade English marks, than in Table XVIII, column 2, showing the prediction of success in first year English from intelligence quotients. Therefore, intelligence quotients seem to be more useful than eighth grade English marks in predicting success in first year English. For practical purposes, however, there is only a slight difference in the degree of accuracy of the prediction of success in first year English from eighth grade English marks and from intelligence quotients.

TABLE XVII

Success in First Year English Predicted from Success in Eighth Grade English

(1) Grade in Eighth Grade English	(2) Predicted Success in First Year English* Y	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Pass
70	70.22±5.43	64.79-75.65	.04	49	51
75	73.36±5.43	67.93-78.79	.61	35	65
80	76.50±5.43	71.07-81.93	1.19	22	78
85	79.64±5.43	74.21-85.07	1.77	12	88
90	82.78±5.43	77.35-88.21	2.35	6	94
95	85.92±5.43	80.49-91.35	2.93	2	98

*The passing mark in Loyola Academy is 70.

TABLE XVIII

Success in First Year English Predicted from Intelligence Quotients

(1) Intelligence Quotients	(2) Predicted Success in First Year English** X	(3) Chances Even That Grade Will Lie Between	(4) $\frac{X}{P.E.}$	(5) Percent Who Will Fail	(5) Percent Who Will Pass
90	71.46±4.90	66.56-76.36	.29	44	56
95	73.28±4.90	68.38-78.18	.66	33	67
100	75.11±4.90	70.21-80.01	1.04	25	75
105	76.93±4.90	72.03-81.83	1.41	17	83
110	78.76±4.90	73.86-83.66	1.78	12	88
115	80.58±4.90	75.68-85.48	2.15	7	93
120	82.41±4.90	77.51-87.31	2.53	5	95
125	84.23±4.90	79.33-89.13	2.90	2	98
130	86.05±4.90	81.15-90.95	3.27	1	99
135	87.88±4.90	82.98-92.78	3.64	1	99
140	89.71±4.90	84.81-94.61	4.02	0	100
145	91.53±4.90	86.63-96.43	4.39	0	100
150	93.36±4.90	88.46-98.26	4.76	0	100

* These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing mark in Loyola Academy is 70.

3. Prediction of Success in Ancient History from Success in Eighth Grade History and Intelligence Quotients

The prediction of success in ancient history in Loyola Academy from eighth grade history marks is reported in Table XIX, column 2. The predicted grade for a pupil with an eighth grade history mark of 70 is 66.97±6.37. The following are the data in column 5 showing the percentages of failure for the eighth grade history marks indicated: 70, 62 percent; 75, 47 percent; 80, 32 percent; 85, 19 percent; 90, 10 percent; and 95, 5 percent.

The large probable error contained in Table XIX, column 2, minimizes the usefulness of eighth grade history marks in predicting success in ancient history in Loyola Academy.

Table XX, column 2, contains the prediction of success in ancient history from intelligence quotients. The chances are even that a pupil with an intelligence quotient of 90 will receive in ancient history a grade between 61.15 and 74.83. According to the law of probabilities, however, a pupil with an intelligence quotient of 90 might receive a grade varying from this estimate as much as four probable errors of ±27.36. Column 5 contains the percentages of failure and of success for the intelligence quotients indicated. The following are the data showing the percentages of failure for the given intelligence quotients: 90, 58 percent; 95, 51 percent; 100, 44 percent; 105, 38 percent; 110, 31 percent; 115, 25 percent, 120, 20 percent, 125, 16 percent; 130, 11 percent, 135,

8 percent; 140, 6 percent; 145, 4 percent; and 150, 3 percent.

The probable error in Table XX, column 2, is large, so that the prediction of success in ancient history in Loyola Academy from intelligence quotients is limited.

If Table XIX, showing the prediction of success in ancient history from grades in eighth grade history, is compared with Table XX, showing the prediction of success in ancient history from intelligence quotients, it seems that eighth grade history marks are more useful than intelligence quotients, because the probable error is somewhat smaller. For practical purposes, however, there is very little difference in the degree of accuracy of the prediction of success in ancient history from eighth grade history marks and from intelligence quotients.

TABLE XIX

Success in Ancient History Predicted from Success in Eighth Grade History

(1) Grade in Eighth Grade History	(2) Predicted Success in Ancient History* Y	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Fail	(5) Percent Will Pass
70	66.97±6.37	60.60-73.34	-.47	62	38
75	70.80±6.37	64.43-77.17	.12	47	53
80	74.61±6.37	68.24-80.98	.72	32	68
85	78.43±6.37	72.06-84.80	1.32	19	81
90	82.25±6.37	75.88-88.62	1.92	10	90
95	86.07±6.37	79.70-92.44	2.52	5	95

*The passing mark in Loyola Academy is 70.

TABLE XX

Success in Ancient History Predicted from Intelligence Quotients

(1) Intelligence Quotients	(2) Predicted Success in Ancient History** X	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Pass
90	67.99±6.84	61.15-74.83	-.29	58	42
95	69.78±6.84	62.94-76.62	-.03	51	49
100	71.59±6.84	64.75-78.43	.23	44	56
105	73.39±6.84	66.55-80.23	.49	38	62
110	75.19±6.84	68.35-82.03	.75	31	69
115	76.99±6.84	70.15-83.83	1.02	25	75
120	78.79±6.84	71.95-85.63	1.28	20	80
125	80.59±6.84	73.75-87.43	1.54	16	84
130	82.39±6.84	75.55-89.23	1.81	11	89
135	84.19±6.84	77.35-91.03	2.07	8	92
140	85.98±6.84	79.14-92.82	2.33	6	94
145	87.79±6.84	80.95-94.63	2.60	4	96
150	89.59±6.84	82.75-96.43	2.86	3	97

* These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing grade in Loyola Academy is 70.

4. Prediction of Success in First Year Latin from Success in Eighth Grade English and Intelligence Quotients

The prediction of success in first year Latin in Loyola Academy from eighth grade English marks is reported in Table XXI, column 2. The following are the data in column 5 showing the percentages of failure for the eighth grade English marks indicated: 70, 55 percent; 75, 44 percent; 80, 33 percent; 85, 22 percent; 90, 15 percent; and 95, 9 percent.

The large probable error in Table XXI minimizes the usefulness of eighth grade English marks in predicting success in first year Latin in Loyola Academy.

Table XXII, column 2, showing the prediction of success in first year Latin from intelligence quotients, is read as follows: the predicted grade for a pupil with an intelligence quotient of 90 is 67.23±6.84, slightly below the passing mark of 70. Column 3 shows for example that the chances are even that the mark of a pupil with an intelligence quotient of 90 will lie between 60.39 and 74.07. That is, 50 percent of the pupils with an intelligence quotient of 90 will receive marks between 60.39 and 74.07. The following are the data in column 5 showing the percentages of failure for the intelligence quotients indicated: 90, 61 percent; 95, 51 percent; 100, 42 percent; 105, 33 percent, 130, 5 percent, 135, 3 percent, 140, 2 percent, 145, 1 percent, and 150, no failures.

The use of intelligence quotients to predict success in first year Latin in Loyola Academy as shown in Table XXII is limited by the large probable error.

Intelligence quotients seem more useful than eighth grade English marks because the probable error in Table XXII, showing the prediction of success in first year Latin from intelligence quotients, is smaller than the probable error in Table XXI, showing the prediction of success in first year Latin from eighth grade English marks. However, there is very little difference in the degree of accuracy of the prediction of success in first year Latin from eighth grade English marks and intelligence quotients.

TABLE XXI

Success in First Year Latin Predicted from Success in Eighth Grade English

(1) Grade in Eighth Grade English	(2) Predicted Success in First Year Latin* Y	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Pass
70	68.41±7.29	61.12-75.70	-.21	55	45
75	71.69±7.29	64.40-78.98	.23	44	56
80	74.96±7.29	67.67-82.25	.68	33	67
85	78.24±7.29	70.95-85.53	1.13	22	78
90	81.51±7.29	74.22-88.80	1.57	15	85
95	84.79±7.29	77.50-92.08	2.02	9	91

* The passing mark in Loyola Academy is 70.

TABLE XXII

Success in First Year Latin Predicted from Intelligence Quotients

(1) Intelligence Quotients	(2) Predicted Success in First Year Latin** X	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Percent Who Will Pass
90	67.23±6.84	60.39-74.07	-.40	61	39
95	69.66±6.84	62.82-76.50	-.05	51	49
100	72.08±6.84	65.24-78.92	.30	42	58
105	74.51±6.84	67.67-81.35	.65	33	67
110	76.93±6.84	70.09-83.77	1.00	25	75
115	79.36±6.84	72.52-86.20	1.37	17	83
120	81.78±6.84	74.94-88.62	1.72	13	87
125	84.21±6.84	77.37-91.05	2.07	8	92
130	86.63±6.84	79.79-93.47	2.43	5	95
135	89.06±6.84	82.22-95.90	2.78	3	97
140	91.48±6;84	84.64-98.32	3.14	2	98
145	93.91±6.84	87.07-100.75	3.49	1	99
150	96.33±6.84	89.49-103.17	3.89	0	100

* These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing grade in Loyola Academy is 70.

5. Prediction of Average Success in First Year from Average Success in a Composite of Eighth Grade Subjects and Intelligence Quotients

Average success in the first year in Loyola Academy is predicted from an eighth grade composite consisting of average success in arithmetic, English, history, reading, and spelling. Table XXIII, column 2, contains the predicted averages for the average marks in the eighth grade composite indicated. The chances are even that a pupil with an average mark of 70 in the eighth grade composite will receive an average marks in first year between 56.72 and 68.56. According to the law of probabilities such a pupil might receive an average mark in first year varying from this estimate as much as four probable errors or±3.68. Column 5 shows that 83 percent of the students having an average of 70 in the eighth grade composite will fail to receive an average mark of 70 in the first year in Loyola Academy. The following data are the percentages of failure for the eighth grade averages indicated: 75, 61 percent; 80, 39 percent; 85, 21 percent; 90, 8 percent; and 95, 3 percent.

The use of the average marks of the eighth grade composite to predict average success in the first year in Loyola Academy reported in Table XXIII is limited by the large probable error. Although the probable error is large this Table presents striking data. An approximate grade of 78 in the eighth grade composite is necessary before a pupil has an even chance of receiving an average grade of 70 in first year high school.

This is in itself amazingly interesting because with an eighth grade composite mark of approximately 78 one who took four subjects in high school would probably fail in two of them. On the other hand, a pupil with an average of 90 in the eighth grade should receive 82.04 within the limits of probabilities in first year high school subjects.

Table XXIV contains the average success in the first year in Loyola Academy predicted from intelligence quotients. The following are the data in column 5 showing the percentages of failure for the intelligence quotients indicated: 90, 51 percent; 95, 42 percent; 100, 33 percent; 105, 24 percent; 110, 17 percent; 115, 12 percent; 120, 9 percent; 125, 5 percent; 130, 3 percent; 135, 2 percent; 140, 1 percent; 145, no failures; and 150, no failures.

If Table XXIII, column 2, showing the prediction of average success in the first year of high school from average success in a composite of eighth grade subjects, is compared with Table XXIV, column 2, showing the prediction of average success in the first year of high school from intelligence quotients, it is noted that intelligence quotients seem to be slightly more useful than average success in a composite of eighth grade subjects, because the probable error in Table XXIV is slightly less than the probable error reported in Table XXIII.

In general, there is only a small difference in the degree of accuracy of the prediction of average success in the first year of high school from average success in a composite of eighth grade subjects and intelligence quotients. However, intelligence quotients are easier to secure and

eighth grade report cards are not always available.

TABLE XXIII

Average Success in First Year High School Predicted from Average Success in a Composite of Eighth Grade Subjects

(1) Average Grade in Eighth Grade Composite	(2) Predicted Average Success in First Year High School** X	(3) Chances Even That Average Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail A	(5) Pass*** B
70	62.64±5.92	56.72-68.56	-1.24	83	17
75	67.49±5.92	61.57-73.41	- .42	61	39
80	72.34±5.92	66.42-78.26	.39	39	61
85	77.19±5.92	71.27-83.11	1.21	21	79
90	82.04±5.92	76.12-87.96	2.03	8	92
95	86.89±5.92	80.97-92.81	2.85	3	97

* This composite consisted of the average success in eighth grade arithmetic, English, history, reading, and spelling.

** The passing mark in Loyola Academy is 70.

*** Column 5, Part A, indicates the percentages who will fail to receive an average passing mark in high school and Part B indicates the percentages who will receive an average passing mark in high school.

TABLE XXIV

Average Success in First Year High School Predicted from Intelligence Quotients

(1) Intelligence Quotients*	(2) Predicted Average Success in First Year High School** X	(3) Chances Even That Average Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail A	(5) Percent Who Will Pass B
90	69.81±5.59	64.22-75.40	-.03	51	49
95	71.81±5.59	66.22-77.40	.32	42	58
100	73.81±5.59	68.22-79.40	.68	33	67
105	75.81±5.59	70.22-81.40	1.03	24	76
110	77.81±5.59	72.22-83.40	1.39	17	83
115	79.81±5.59	74.22-85.40	1.75	12	88
120	81.81±5.59	76.22-87.40	2.11	9	91
125	83.81±5.59	78.22-89.40	2.47	5	95
130	85.81±5.59	80.22-91.40	2.82	3	97
135	87.81±5.59	82.22-93.40	3.18	2	98
140	89.81±5.59	84.22-95.40	3.54	1	99
145	91.81±5.59	86.22-97.40	3.90	0	100
150	93.81±5.59	88.22-99.40	4.25	0	100

*These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing mark in Loyola Academy is 70.

***Column 5, part A, indicates percentages who will fail to receive average passing mark in high School; part B indicates percentages who will not fail.

6. Prediction of Success in American History from Success in Ancient History and Intelligence Quotients

Table XXV which indicates the degree of success in American History in Loyola Academy predicted from success in ancient history is read as follows: the predicted grade for a pupil with a mark of 70 in ancient history is 70.13±2.89. In column 3 it may be noted that the chances are even that such a pupil's American History mark will lie between 67.24 and 73.02. The following are the data in column 5 showing the percentages of failure for the ancient history marks indicated; 70, 49 percent; 75, 24 percent; 80, 4 percent; 85, 1 percent; 90, no failures; and 95, no failures.

The probable error in Table XXV is rather small, therefore, grades in ancient history are useful in predicting success in American History.

Table XXVI, column 2, contains the prediction of success in American History from intelligence quotients. The percentages of failure for the indicated intelligence quotients follow: 90, 75 percent; 95, 61 percent; 100, 47 percent; 105, 33 percent; 110, 20 percent; 115, 11 percent; 120, 6 percent; 125, 2 percent; 130, 1 percent; 135, no failures; 140, no failures; 145, no failures; and 150, no failures.

The large probable error in Table XXVI limits the usefulness of intelligence quotients in predicting success in American History.

Ancient history marks seem to be more useful than intelligence quotient because the probable error is much smaller in Table XXV, showing the prediction of success in American History from success in ancient history,

than in Table XXVI, showing the prediction of Success in American History from intelligence quotients. Ancient history marks are practicable for forecasting purposes because they are easily obtained from the official school records.

TABLE XXV

Success in American History Predicted from Success in Ancient History

(1) Grade in Ancient History	(2) Predicted Success in American History* Y	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Pass
70	70.13±2.89	67.24-73.02	.04	49	51
75	73.82±2.89	70.93-76.61	1.32	24	76
80	77.51±2.89	74.62-80.40	2.58	4	96
85	81.20±2.89	78.31-84.09	3.87	1	99
90	84.89±2.89	82.00-87.78	5.15	0	100
95	88.58±2.89	85.69-91.47	6.42	0	100

*The passing mark in Loyola Academy is 70.

TABLE XXVI

Success in American History Predicted from Intelligence Quotients

(1) Intelligence Quotients*	(2) Predicted Success in American History** X	(3) Chances Even That Grade Will Lie Between	(4) $\frac{x}{P.E.}$	(5) Percent Who Will Fail	(5) Percent Who Will Pass
90	65.38±4.61	60.77-69.99	-1.00	75	25
95	67.94±4.61	63.33-72.55	- .44	61	39
100	70.55±4.61	65.94-75.16	.11	57	53
105	73.16±4.61	68.55-77.77	.68	33	67
110	75.77±4.61	71.16-80.38	1.25	20	80
115	78.38±4.61	73.77-82.99	1.81	11	89
120	80.99±4.61	76.38-85.60	2.38	6	94
125	83.60±4.61	78.99-88.21	2.95	2	96
130	86.21±4.61	81.60-90.82	3.51	1	99
135	88.82±4.61	84.21-93.43	4.08	0	100
140	91.43±4.61	86.82-96.04	4.64	0	100
145	94.04±4.61	89.43-98.65	5.21	0	100
150	96.65±4.61	92.04-101.25	5.78	0	100

*These intelligence quotients were obtained from the Terman Group Test of Mental Ability, Form A.

** The passing mark in Loyola Academy is 70.

General Conclusions

The prediction of success in first year algebra, English, history and Latin from a pupil's marks in specific eighth grade subjects, and from intelligence quotients, and the prediction of success in American History from success in ancient history and from intelligence quotients seem to warrant these general conclusions:

1. Success in first year algebra, English, history, and Latin may be predicted about as well from success in specific eighth grade subjects as from intelligence quotients.

2 A. The probable errors reported for the prediction of success in algebra from success in eighth grade arithmetic and from intelligence quotients are ±7.16 and ±6.96, respectively.

B. The probable errors reported for the prediction of success in English from success in eighth grade English and from intelligence quotients are ±5.43 and ±4.90, respectively.

C. The probable errors reported for the prediction of success in ancient history from success in eighth grade history and from intelligence quotients are ±6.37 and ±6.84, respectively.

D. The probable errors reported for the prediction of success in Latin from success in eighth grade English and from intelligence quotients are ±7.29 and ±6.84, respectively.

E. The probable errors reported for the prediction of average success in the first year of high school from a composite of average success in specific eighth grade subjects and from intelligence quotients are ±5.92 and ±5.59, respectively.

2. Intelligence quotients are more practicable than marks in specific eighth grade subjects to predict success in first year high school subjects because they are easier to obtain.

3. Marks in ancient history are more useful than intelligence quotients to predict success in American History.

A. The probable error reported for the prediction of success in American History from success in ancient history and from intelligence quotients are ±2.89 and ±4.61, respectively.

BIBLIOGRAPHY

1. Brooks, Fowler D. "Sectioning Junior High-School Pupils by Tests and School Marks." Journal of Educational Research 12:359-369, December, 1925.

2. Capps, Guy H. The Value of the Terman Group Test of Mental Ability as a Means of Predicting the Success of Students in the First Year of High School. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1922.

3. Chaddock, Robert E. Principles and Methods of Statistics. Boston: Houghton Mifflin Company, 1925. XVI + 471p.

4. Colvin, Stephen S. "Principles Underlying the Construction and Use of Intelligence Tests." Twenty-First Yearbook, Part I. National Society for the Study of Education. Bloomington, Illinois: Public School Publishing Company, 1923. p.11-44.

5. Courter, Claude V. A Study of Factors Which Condition Success in Plane Geometry. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1925.

6. Flemming, Cecile W. A Detailed Analysis of Achievement in the High School. Contributions to Education, No. 196. New York: Bureau of Publications, Teachers College, Columbia University, 1925. 209p.

7. Franzen, Raymond. "Attempts at Test Validation." Journal of Educational Research 6:145-158, September, 1922.

8. French, John M. The Value of Tests and Teachers' Marks as a Means of Predicting the Success of Students in High School. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1927.

9. Good, Warren R. The Elements of Statistics. Ann Arbor: The Ann Arbor Press, 1933, 28p.

10. Haggerty, M.E. "Intelligence Examination Delta 2." Journal of Educational Psychology 14:257-277, May, 1923.

11. Hoke, Rex L. The Correlation of Intelligence and Scholarship in the High School Subjects. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1926.

12. Holzinger, Karl J. Statistical Methods for Students in Education. Boston: Ginn and Company, 1928. VIII + 372p.

13. Hooks, Nall T. A Study in High School Prognosis. Unpublished Master's Thesis, University of Kentucky, Lexington, Kentucky, 1928.

14. Jordan, A.M. "Correlations of Four Intelligence Tests with Grades." Journal of Educational Psychology 13:419-429, October, 1922.

15. Lange, Irene D. The Value of the Otis Self-Administering Test of Mental Ability as a Means of Predicting the Success of Pupils in Junior High School. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1927.

16. Lindquist, Everett F. and Stoddard, George D. Study Manual in Elementary Statistics. New York: Longmans, Green and Company, 1929. VII + 109p.

17. Ludlow, William G. The Correlation of Certain Standardized Test Scores and Semester Marks of High School Pupils. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1929.

18. Odell, C.W. Educational Statistics. New York: The Century Company, 1925. IX + 334p.

19. Pintner, Rudolph. Intelligence Testing. New York: Henry Holt and Company, 1931. XII + 555p.

20. Proctor, William M. "The Use of Intelligence Tests in the Educational Guidance of High-School Pupils." School and Society 8:473-478, 502-509, October 19, October 26, 1918.

21. Proctor, William M. "Psychological Tests as a Means of Measuring the Probable School Success of High-School Pupils." Journal of Educational Research 1:258-270, April, 1920.

22. Rector, William G. "A Study in the Prediction of High School Success." Journal of Educational Psychology 16:28-37, January, 1925.

23. Ross, Clay C. The Relation Between Grade School Record and High School Achievement. Contribution to Education, No. 166, New York: Bureau of Publications, Teachers College, Columbia University, 1925. 70p.

24. Schmitz, Sylvester. "The Predictive Value of Intelligence Tests in the High School." The National Benedictine Educational Association Bulletin. Vol.15, No.3, March, 1933. Atchison,Kansas: St. Benedict's College. p.65-81.

25. Schmitz, Sylvester. "The Predictive Value of Intelligence Tests in the High School." The National Benedictine Educational Association Bulletin. Vol.16, No.3, March, 1934. Atchison, Kansas: St. Benedict's College. p.59-64.

26. Standley, Lyman L. A Study of the Individual Ability of Pupils by Means of Mental Tests and School Marks. Unpublished Master's Thesis, University of Chicago, Chicago,Illinois, 1922.

27. Symonds, Percival M. Measurement in Secondary Education. New York: The Macmillan Company, 1927. XVII + 588p.

28. Terman, Lewis M. Manual of Directions: Terman Group Test of Mental Ability. New York: World Book Company, 1920. 12p.

29. Todd, Gertrude E. An Analysis of Intelligence Tests to Determine Their Predictive Value with High School Subjects. Unpublished Master's Thesis, University of Chicago, Chicago, Illinois, 1928.

30. Trabue, M.R. "The Use of Intelligence Tests in Junior High School." Twenty-First Yearbook, Part I. National Society for the Study of Education. Bloomington,Illinois: Public School Publishing Company, 1923. p.169-188.

31. West, Roscoe L. "An Experiment with the Otis Group Intelligence Scale in the Needham, Massachusetts, High School." Journal of Educational Research 3:261-268, April, 1921.

32. Whaley, Myrtle W. The Relation Between the Derived Intelligence Score and Achievement in Social Sciences for Grades IX-XII. Unpublished Master's Thesis,University of Chicago, Chicago Illinois, 1931.

33. Woody, Clifford and Sangren, Paul V. Administration of the Testing Program. New York: World Book Company, 1933. XI + 397p.

APPENDIX

PROBLEM: _____

X SCALE REPRESENTS High School English (first year)

Y SCALE REPRESENTS Intelligence Quotients

	50 52	53 55	56 58	59 61	62 64	65 67	68 70	71 73	74 76	77 79	80 82	83 85	86 88	89 91	92 94	95 97	98 100	f	d	fd_y	fd_y^2	xy +	xy −
	-100	-90	-80	-70	-60	-50	-40	-30	-20	-10		10	20	30	40	50	60	70	80	90	100							
	-90	-81	-72	-63	-54	-45	-36	-27	-18	-9		9	18	27	36	45	54	63	72	81	90							
	-80	-72	-64	-56	-48	-40	-32	-24	-16	-8		8	16	24	32	40	48	56	64	72	80							
159 165	-70	-63	-56	-49	-42	-35	-28	-21	-14	-7		7	14	21	28 28	35	42	49	56	63	70	1	7	7	49	28	0	
147 153	-60	-54	-48	-42	-36	-30	-24	-18	-12 -12	-6		6 6	12	18 18	24	30	36	42	48	54	60	3	6	18	108	24	12	
142 148	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5		5	10 10	45 15	20 20	25	30	35	40	45	50	5	5	25	125	75 55	0	
137 133	-40	-36	-32	-28	-24	-20	-16	-12	-8	-4		4	8 8	12	16	20 20	24	28	32	36	40	2	4	8	32	28	0	
132 128	-30	-27	-24	-21	-18	-15	-12	-9	-6	-3 -3		6 3	6 6	27 9	12 12	15	18	21	24	27	30	8	3	24	72	51	3	
127 123	-20	-18	-16	-14	-12	-10	-8	-6	-4 -4	-2		2	8 4	18 6	8	10	12	14	16	18	20	7	2	14	28	26	4	
122 118	-10	-9	-8	-7	-6	-5	-4	-6 -3	-6 -2	-2 -1		2 1	4 2	3	4 4	5	6	7	8	9	10	15	1	15	15	10	14	
117 113																		19										
112 108	10	9	8	7	6	5	4	3	6 2	3 1		-4 -1	-6 -2	-3	-4	-5	-6	-7	-8	-9	-10	16	-1	-16	16	9	10	
107 103	20 20	18	16	14 14	12	10	8	12 6	12 4	6 2		-10 -2	-8 -4	-6	-8	-10	-12	-14	-16	-18	-20	20	-2	-40	80	64	18	
102 98	30	27	24	21	18	30 15	12	36 9	6 6	6 3		-3	-6 -6	-9	-12	-15	-18	-21	-24	-27	-30	11	-3	-33	99	78	6	
97 93	40 40	36	32	28 28	24	20	16	36 12	8 8	4		-4 -4	-8 -8	-12	-16	-20	-24	-28	-32	-36	-40	8	-4	-32	128	112	12	
92 88	50	45	40	35	30	25	20	30 15	10	5		-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	2	-5	-10	50	30	0	
87 83	60 60	54	48	42	36	30	24	18	12	6		-6	-12	-18	-24	-30	-36	-42	-48	-54	-60	1	-6	-6	36	60	0	
82 78	70 70	63	56	49	42	35	28	21	14	7 7		-7	-14	-21	-28	-35	-42	-49	-56	-63	-70	2	-7	-14	98	77	0	
	80	72	64	56	48	40	32	24	16	8		-8	-16	-24	-32	-40	-48	-56	-64	-72	-80		-8					
	90	81	72	63	54	45	36	27	18	9		-9	-18	-27	-36	-45	-54	-63	-72	-81	-90		-9					
	100	90	80	70	60	50	40	30	20	10		-10	-20	-30	-40	-50	-60	-70	-80	-90	-100		-10					
f	4	0	0	2	0	3	0	14	13	17	15	18	14	14	5	1												
d	10	-9	-8	-7	-6	-5	-4	-3	-2	-1		1	2	3	4	5	6	7	8	9	10	Σ120	-40	936		62	79	ΣXY = 573
x	-40	0	0	-14	0	-15	0	-42	-26	-17		18	28	42	20	5						-41						
x^2	400	0	0	98	0	75	0	126	52	17		18	56	126	80	25						1073						

$$\sigma_x = \sqrt{\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2} = 2.95 \qquad \left(\frac{3.9916}{\quad} \quad \frac{.1043}{\quad}\right)$$

$$\sigma_y = \sqrt{\frac{\Sigma y^2}{N} - \left(\frac{\Sigma y}{N}\right)^2} = 2.77 \qquad \left(\frac{7.8}{\quad} \quad \frac{.1111}{\quad}\right)$$

$M_x = 79.977$

$M_y = 113.35$

$$r = \frac{\frac{\Sigma xy}{N} - \left(\frac{\Sigma x}{N} \cdot \frac{\Sigma y}{N}\right)}{\sqrt{\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2}\sqrt{\frac{\Sigma y^2}{N} - \left(\frac{\Sigma y}{N}\right)^2}}$$

$$= \frac{4.775 - .114}{\sqrt{8.8373}\ \sqrt{7.6889}}$$

$$= \frac{4.661}{8.1715}$$

$r = .5703$

$P.E._r = .6745 \frac{1-r^2}{\sqrt{N}} = .0416$

TERMAN GROUP TEST OF MENTAL ABILITY

For Grades 7 to 12

Prepared by Lewis M. Terman, Stanford University, California

EXAMINATION: FORM A

1. Name ..... (First name / Last name)
2. Boy or girl.....Grade.....High or Low.....
3. Age last birthday.....Date of birthday..... (Month / Day / Year)
4. Name of city (or county).....
5. Name of school.....
6. Name of teacher.....
7. Date of this examination.....19..... (Month / Day / Year)

Do not turn the page until you are told to.

Test	Score	Remarks or Further Data
1. Information		
2. Best Answer		
3. Word Meaning		
4. Logical Selection		
5. Arithmetic		
6. Sentence Meaning		
7. Analogies		
8. Mixed Sentences		
9. Classification		
10. Number Series		
Total		

TEST 1. INFORMATION

Draw a line under the ONE word that makes the sentence true, as shown in the sample.

SAMPLE. Our first President was
Adams Jefferson Lincoln <u>Washington</u>

1 Coffee is a kind of
bark berry leaf root .....
2 Sirloin is a cut of
beef mutton lamb veal .....
3 Gasoline comes from
grains petroleum turpentine seeds .....
4 Most exports go from
Boston San Francisco New Orleans New York .
5 The number of pounds in a ton is
1000 2000 3000 4000 .....

6 Napoleon was finally defeated at
Leipzig Paris Verdun Waterloo .....
7 Emeralds are usually
blue green red yellow .....
8 The optic nerve is for
seeing hearing tasting feeling .....
9 Larceny is a term used in
medicine theology law pedagogy .....
10 Sponges come from
animals farms forests mines .....

11 Confucius founded the religion of the
Persians Italians Chinese Indians .....
12 The larynx is in the
abdomen head throat shoulder .....
13 The piccolo is used in
farming music photography typewriting .....
14 The kilowatt measures
rainfall wind-power electricity water-power ....
15 The guillotine causes
death disease fever sickness .....

16 A character in " David Copperfield " is
Sindbad Uriah Heep Rebecca Hamlet .....
17 A windlass is used for
boring cutting lifting squeezing .....
18 A great law-giver of the Hebrews was
Abraham David Moses Saul .....
19 A six-sided figure is called a
scholium parallelogram hexagon trapezium ....
20 A meter is nearest in length to the
inch foot yard rod .....

Right.....

TEST 2. BEST ANSWER

Read each question or statement and make a cross before the BEST answer, as shown in the sample.

SAMPLE
Why do we buy clocks? Because
1 We like to hear them strike.
2 They have hands.
× 3 They tell us the time.

1 **Spokes of a wheel are often made of hickory because**
1 Hickory is tough.
2 It cuts easily.
3 It takes paint nicely.

2 **The saying, " A watched pot never boils," means**
1 We should never watch a pot on the fire.
2 Boiling takes a long time.
3 Time passes slowly when we are waiting for something.

3 **A train is harder to stop than an automobile because**
1 It has more wheels.
2 It is heavier.
3 Its brakes are not so good.

4 **The saying, " Make hay while the sun shines," means**
1 Hay is made in summer.
2 We should make the most of our opportunities.
3 Hay should not be cut at night.

5 **If the earth were nearer the sun**
1 The stars would disappear.
2 Our months would be longer.
3 The earth would be warmer.

6 **The saying, " If wishes were horses, beggars would ride," means**
1 Wishing doesn't get us very far.
2 Beggars often wish for horses to ride.
3 Beggars are always asking for something.

7 **The saying, " Little strokes fell great oaks," means**
1 Oak trees are weak.
2 Little strokes are best.
3 Continued effort brings results.

8 **A steel battleship floats because**
1 The engines hold it up.
2 It has much air space inside.
3 It contains some wood.

9 **The feathers on a bird's wings help him to fly because**
1 They make a wide, light surface.
2 They keep the air off his body.
3 They decrease the bird's weight.

10 **The saying, " A carpenter should stick to his bench," means**
1 Carpenters should not work without benches.
2 Carpenters should not be idle.
3 One should work at the thing he can do best.

11 **The saying, " One swallow does not make a summer," means**
1 Swallows come back for the summer.
2 A single sign is not sufficient proof.
3 Many birds add to the pleasures of summer.

Right.....× 2 = *Score*.....

TEST 3. WORD MEANING

When two words mean the SAME, draw a line under "SAME."
When they mean the OPPOSITE, draw a line under "OPPOSITE."

SAMPLES	fall — drop	same — opposite	
	north — south	same — opposite	
1	expel — retain	same — opposite	1
2	comfort — console	same — opposite	2
3	waste — conserve	same — opposite	3
4	monotony — variety	same — opposite	4
5	quell — subdue	same — opposite	5
6	major — minor	same — opposite	6
7	boldness — audacity	same — opposite	7
8	exult — rejoice	same — opposite	8
9	prohibit — allow	same — opposite	9
10	debase — degrade	same — opposite	10
11	recline — stand	same — opposite	11
12	approve — veto	same — opposite	12
13	amateur — expert	same — opposite	13
14	evade — shun	same — opposite	14
15	tart — acid	same — opposite	15
16	concede — deny	same — opposite	16
17	tonic — stimulant	same — opposite	17
18	incite — quell	same — opposite	18
19	economy — frugality	same — opposite	19
20	rash — prudent	same — opposite	20
21	obtuse — acute	same — opposite	21
22	transient — permanent	same — opposite	22
23	expel — eject	same — opposite	23
24	hoax — deception	same — opposite	24
25	docile — submissive	same — opposite	25
26	wax — wane	same — opposite	26
27	incite — instigate	same — opposite	27
28	reverence — veneration	same — opposite	28
29	asset — liability	same — opposite	29
30	appease — placate	same — opposite	30

Right.....*Wrong*.....*Score*.....

TEST 4. LOGICAL SELECTION

In each sentence draw a line under the TWO words that tell what the thing ALWAYS has. Underline TWO, and ONLY TWO, in each line.

SAMPLE. A **man** always has
body **cap** **gloves** **mouth** **money**

1 A **horse** always has
harness **hoofs** **shoes** **stable** **tail** 1
2 A **circle** always has
altitude **circumference** **latitude** **longitude** **radius** 2
3 A **bird** always has
bones **eggs** **beak** **nest** **song** 3
4 **Music** always has
listener **piano** **rhythm** **sound** **violin** 4
5 An **object** always has
smell **size** **taste** **value** **weight** 5
6 **Conversation** always has
agreement **persons** **questions** **wit** **speech** 6
7 A **banquet** always has
food **music** **persons** **speeches** **toastmaster** 7
8 A **pistol** always has
barrel **bullet** **cartridge** **sights** **trigger** 8
9 A **ship** always has
engine **guns** **keel** **rudder** **sails** 9
10 A **debt** always involves
creditor **debtor** **interest** **mortgage** **payment** 10
11 A **game** always has
cards **contestants** **forfeits** **penalties** **rules** 11
12 A **magazine** always has
advertisements **paper** **pictures** **print** **stories** 12
13 A **museum** always has
animals **arrangement** **collections** **minerals** **visitors** 13
14 A **forest** always has
animals **flowers** **shade** **underbrush** **trees** 14
15 A **citizen** always has
country **occupation** **privileges** **property** **vote** 15
16 **Controversy** always involves
claims **disagreement** **dislike** **enmity** **hatred** 16
17 **War** always has
airplanes **cannons** **combat** **rifles** **soldiers** 17
18 **Obstacles** always bring
difficulty **discouragement** **failure** **hindrance** **stimulation** .. 18
19 **Abhorrence** always involves
aversion **dislike** **fear** **rage** **timidity** 19
20 **Compromise** always involves
adjustment **agreement** **friendship** **respect** **satisfaction** ... 20

Right.....

TEST 5. ARITHMETIC

Find the answers as quickly as you can.
Write the answers on the dotted lines.
Use the bottom of the page to figure on.

1 How many hours will it take a person to go 66 miles at the rate of 6 miles an hour? *Answer*.....

2 At the rate of 2 for 5 cents, how many pencils can you buy for 50 cents? *Answer*.....

3 If a man earns $20 a week and spends $14, how long will it take him to save $300? *Answer*.....

4 $2 \times 3 \times 4 \times 6$ is how many times as much as 3×4? *Answer*.....

5 If two pies cost 66 cents, what does a sixth of a pie cost? *Answer*.....

6 What is $16\frac{2}{3}$ per cent of $120? *Answer*.....

7 4 per cent of $1000 is the same as 8 per cent of what amount? *Answer*.....

8 A has $180, B has $\frac{2}{3}$ as much as A, and C has $\frac{1}{2}$ as much as B. How much have all together? *Answer*.....

9 The capacity of a rectangular bin is 48 cubic feet. If the bin is 6 feet long and 4 feet wide, how deep is it? *Answer*.....

10 If it takes 7 men 2 days to dig a 140-foot ditch, how many men are needed to dig it in half a day? *Answer*.....

11 A man spends $\frac{1}{4}$ of his salary for board and room, and $\frac{3}{8}$ for all other expenses. What per cent of his salary does he save? *Answer*.....

12 If a man runs 100 **yards** in 10 seconds, how many **feet** does he run in $\frac{1}{5}$ of a second? *Answer*.....

Right.....$\times 2 =$ *Score*.....

FORM A

TEST 6. SENTENCE MEANING

Draw a line under the right answer, as shown in the samples.

SAMPLES	Is coal obtained from mines?	Yes	No	
	Are all men six feet tall?	Yes	No	
1	Does a conscientious person ever make mistakes?	Yes	No	1
2	Is an alloy a kind of musical instrument?	Yes	No	2
3	Is scurvy a kind of medicine?	Yes	No	3
4	Are mysterious things often uncanny?	Yes	No	4
5	Are destitute persons often subjects of charity?.....	Yes	No	5
6	Are anonymous letters ever properly signed?	Yes	No	6
7	Is the mimeograph sometimes used by stenographers?.	Yes	No	7
8	Is a curriculum intended for horses?.....	Yes	No	8
9	Are proteids essential to health?	Yes	No	9
10	Does " perfunctory " mean the same as " careful "?..	Yes	No	10
11	Are premeditated deeds always wicked?	Yes	No	11
12	Do alleged facts often require verification?	Yes	No	12
13	Are sheep carnivorous?	Yes	No	13
14	Are aristocrats subservient to their inferiors?	Yes	No	14
15	Are venerable people usually respected?	Yes	No	15
16	Is clematis sometimes cultivated?	Yes	No	16
17	Are ultimate results the last to appear?.....	Yes	No	17
18	Are cerebral hemorrhages helpful to thinking?.....	Yes	No	18
19	Are all people religious who have hallucinations?.....	Yes	No	19
20	Are intermittent sounds discontinuous?.....	Yes	No	20
21	Are sable colors preferred for nations' flags?.....	Yes	No	21
22	Does social contact tend to reduce eccentricities?....	Yes	No	22
23	Are tentative decisions usually final?.....	Yes	No	23
24	Is rancor usually characterized by persistence?.....	Yes	No	24

Right.....*Wrong*.....*Score*.....

TEST 7. ANALOGIES

SAMPLES
- **Ear** is to **hear** as **eye** is to
  table <u>see</u> hand play
- **Hat** is to **head** as **shoe** is to
  arm coat <u>foot</u> leg

Do them all like samples.

1 **Coat** is to **wear** as **bread** is to
eat starve water cook 1

2 **Week** is to **month** as **month** is to
year hour minute century 2

3 **Monday** is to **Tuesday** as **Friday** is to
week Thursday day Saturday 3

4 **Tell** is to **told** as **speak** is to
sing spoke speaking sang 4

5 **Lion** is to **animal** as **rose** is to
smell leaf plant thorn 5

6 **Cat** is to **tiger** as **dog** is to
wolf bark bite snap 6

7 **Success** is to **joy** as **failure** is to
sadness luck fail work 7

8 **Liberty** is to **freedom** as **bondage** is to
negro slavery free suffer 8

9 **Cry** is to **laugh** as **sadness** is to
death joy coffin doctor 9

10 **Tiger** is to **hair** as **trout** is to
water fish scales swims 10

11 **1** is to **3** as **9** is to
18 27 36 45 11

12 **Lead** is to **heavy** as **cork** is to
bottle weight light float 12

13 **Poison** is to **death** as **food** is to
eat bird life bad 13

14 **4** is to **16** as **5** is to
7 45 35 25 14

15 **Food** is to **hunger** as **water** is to
drink clear thirst pure 15

16 **b** is to **d** as **second** is to
third later fourth last 16

17 **City** is to **mayor** as **army** is to
navy soldier general private 17

18 **Here** is to **there** as **this** is to
these those that then 18

19 **Subject** is to **predicate** as **noun** is to
pronoun adverb verb adjective 19

20 **Corrupt** is to **depraved** as **sacred** is to
Bible hallowed prayer Sunday 20

Right .....

TEST 8. MIXED SENTENCES

The words in each sentence below are mixed up. If what a sentence means is TRUE, draw a line under "TRUE." If what it means is FALSE, draw a line under "FALSE."

SAMPLES
- hear are with to ears ..... <u>true</u> false
- eat gunpowder to good is ..... true <u>false</u>

1 true bought cannot friendship be ..... true false 1

2 good sea drink to is water ..... true false 2

3 of is the peace war opposite ..... true false 3

4 get grow they as children taller older ..... true false 4

5 horses automobile an are than slower ..... true false 5

6 never deeds rewarded be should good ..... true false 6

7 four hundred all pages contain books ..... true false 7

8 to advice sometimes is good follow hard ..... true false 8

9 envy bad greed traits are and ..... true false 9

10 grow an than strawberries oak tree higher ..... true false 10

11 external deceive never appearances us ..... true false 11

12 never is man what show a deeds ..... true false 12

13 hatred bad unfriendliness traits are and ..... true false 13

14 often judge can we actions man his by a ..... true false 14

15 in are always American cities born presidents ..... true false 15

16 certain always death of cause kinds sickness ..... true false 16

17 are sheet blankets as as a never warm ..... true false 17

18 never who heedless those stumble are ..... true false 18

Right ..... *Wrong* ..... *Score* .....

TEST 9. CLASSIFICATION

SAMPLES { 1 bullet cannon gun sword pencil
2 Canada Chicago China India France

In each line cross out the word that does not belong there. Cross out JUST ONE WORD in each line.

1	Frank James John Sarah William	1
2	Baptist Catholic Methodist Presbyterian Republican	2
3	automobile bicycle buggy telegraph train	3
4	Collie Holstein Shepherd Spitz Terrier	4
5	hop run skip stand walk	5
6	death grief picnic poverty sadness	6
7	bed chair dish sofa table	7
8	hard rough smooth soft sweet	8
9	mechanic doctor lawyer preacher teacher	9
10	Christ Confucius Mohammed Moses Cæsar	10
11	butterfly hawk ostrich robin swallow	11
12	cloth cotton flax hemp wool	12
13	digestion hearing sight smell touch	13
14	down hither recent up yonder	14
15	anger hatred joy pity reasoning	15
16	Australia Cuba Iceland Ireland Spain	16
17	Dewey Farragut Grant Paul Jones Schley	17
18	give lend lose keep waste	18

Right.....

TEST 10. NUMBER SERIES

SAMPLES { 5 10 15 20 25 30 35
20 18 16 14 12 10 8

In each row try to find out how the numbers are made up, then on the two dotted lines write the TWO numbers that should come next.

1st Row			8	7	6	5	4	3	....
2d Row		3	8	13	18	23	28	....	
3d Row		$11\frac{3}{4}$	12	$12\frac{1}{4}$	$12\frac{1}{2}$	$12\frac{3}{4}$	....		
4th Row			8	8	6	6	4	4	....
5th Row		1	2	4	8	16	32	....	
6th Row		4	3	5	4	6	5	7	....
7th Row			16	8	4	2	1	$\frac{1}{2}$	....
8th Row		8	9	12	13	16	17	....	
9th Row	7 11	15	16	20	24	25	29	....	
10th Row	31.3	40.3	49.3	58.3	67.3	76.3	....		
11th Row				$\frac{1}{25}$	$\frac{1}{5}$	1	5	....	
12th Row			3	4	**6**	9	13	18	....

Right..... × 2 = *Score*.....

Copy of Terman Group Test of Mental Ability, Form A

The thesis, "The Prediction of Scholastic Success by Intelligence Tests and Scholastic Grades," written by John Stafford Hazard, has been accepted by the Graduate School of Loyola University, with reference to form, and by the readers whose names appear below, with reference to content.. It is, therefore, accepted as a partial fulfilment of the requirements for the degree of Master of Arts.

Dr. James A. Fitzgerald November 22,1934

Rev. Austin G. Schmidt, S.J. December 1, 1934